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Introduction

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By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts* is issued in coordination with *STAR*. Each journal appears on alternate weeks. *IAA* uses subject categories identical with those in *STAR*, and publishes similar indexes. *IAA's* worldwide coverage of books and scientific and trade journals complements *STAR's* worldwide report coverage. The two publications thus provide comprehensive access to current literature on aerospace science and technology.

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INDEXING VOCABULARY

The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is being used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted for a total picture of the current indexing vocabulary including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at a price of $8.50 for the three-volume set.

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02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **603**

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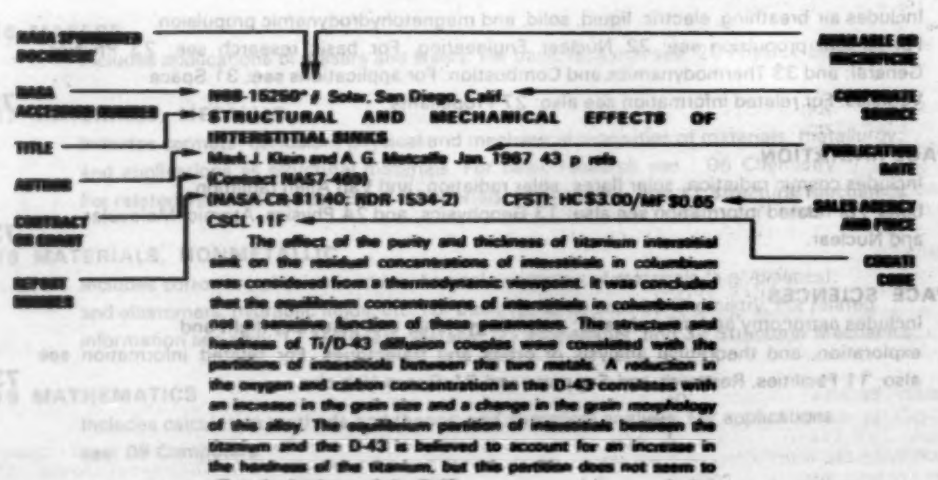
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N68-15250* # Solar, San Diego, Calif.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
(NASA-CR-81140; RDR-1534-2) CFSTI: HC $3.00/MF $0.65
CSCL 11F
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, external flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N68-13908 Wissenschaftliche Gesellschaft fuer Luft- und Raumfahrt, Brunswick (West Germany).
MEETING REPORT OF THE WGLR TECHNICAL COMMITTEE ON AERODYNAMICS—HYPERSOUND AERODYNAMICS [BERICHT UEBER DIE SITZUNG DES WGLR-FACHAUSSCHUSSES AERODYNAMIK—HYPERSCHALLAERODYNAMIK]
Jul. 1967 155 p refs In GERMAN Meeting held at Munich, 9 Dec. 1966
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N68-13909 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Aachen (West Germany).
RESEARCH WORKS CONDUCTED AT THE DVL INSTITUTE FOR THEORETICAL GAS DYNAMICS ON THE SUBJECT OF HYPERSOUND AERODYNAMICS [ARBEITEN AUF DEM GEBIET DER HYPERSCHALLAERODYNAMIK IM DVL-INSTITUT FUER THEORETISCHE GASDYNAMIK]
W. Schneider *In* WGLR Meeting Rept. of the WGLR Tech. Comm. on Aerodyn.—Hypersound Aerodyn. Jul. 1967 p 7-33 refs In GERMAN (See N68-13908 05-01)

Theoretical work presented evaluates the hypersonic flow around pointed profiles and rotational blunt bodies. The problems of transonic leading edges for delta wings at high Mach flows and the effects of real gases on the hypersonic flow around an upright circular cone are discussed. Also included is a brief description of an analytical solution for inverse problems commonly found in local subsonic, sonic, and hypersonic gas flow dynamics.
Transl. by G.G.

N68-13910 Bolkow Entwicklungen K. G., Munich (West Germany).
CALCULATING THE FRICTIONLESS SUPERSONIC FLOW FIELD AROUND BLUNT BODIES OF REVOLUTION WITH OR WITHOUT INCIDENCE [BERECHNUNG DES REIBUNGS-FREIEN UEBERSCHALLSTROEMUNGSFELDES UM STUMPFE ROTATIONSKOERPER MIT UND OHNE ANSTELLUNG]
P. Mitselbach *In* WGLR Meeting Rept. of the WGLR Tech. Comm. on Aerodyn.—Hypersonic Aerodyn. Jul. 1967 p 34-58 refs In GERMAN (See N68-13908 05-01)

This brief survey contains calculation methods for the frictionless supersonic and hypersonic flow around blunt bodies. Numerical integral and nonlinear approximation analyses are performed for: non-incident blunt or pointed bodies of revolution in ideal gas flows, and for pointed bodies of revolution in equilibrium gas flows. Contour transformations are approximated for an axisymmetric problem solution and the results are checked by wind tunnel tests.
Transl. by G.G.

N68-13911 Aerodynamische Versuchsanstalt, Gottingen (West Germany).
FLOW FIELD AROUND BLUNT BODIES WITH CONSIDERATION OF IDEAL GAS EFFECTS (OSCILLATION-RELAXATION) [DAS STROEMUNGSFELD AN STUMPFEN KOERPERN UNTER BERUECKSICHTIGUNG REALER GASEFFEKTE (SCHWINGUNGSRELAXATION)]

W. Wuest *In* WGLR Meeting Rept. of the WGLR Tech. Comm. on Aerodyn.—Hypersound Aerodyn. Jul. 1967 p 59–87 refs In GERMAN (See N68-13908 05-01)

Relaxation phenomena in the hypersonic flow field around blunt bodies are evaluated by establishing the thermodynamic equilibrium deviations caused by vibrational relaxation in real gas. Changes in vibrational energy at 3000°K follow the changes in molecular transformation and rotation energies with a certain delay. A one-dimensional hypersonic nozzle flow model is used to calculate thermodynamic gas behavior under vibrational relaxation, vibrational equilibrium, and stationary vibrations and is then extended to include the behavior of the symmetric compressible shock flow around blunt bodies. Transl. by G.G.

N68-13914 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany).

EXPERIMENTAL FLOW FIELD INVESTIGATIONS NEAR THE SHARP LEADING EDGE OF A COOLED FLAT PLATE IN A HYPERVELOCITY, LOW DENSITY FLOW [EXPERIMENTELLE STROEMUNGSFELDUNTERSUCHUNGEN NAHE DER SCHARFEN VORDERKANTE EINER GEKUEHLTEN, EBENEN PLATTE IN EINER HYPERSONISCHEN STROEMUNG NIEDRIGER DICHTE]

M. Becker *In* WGLR Meeting Rept. of the WGLR Tech. Comm. on Aerodyn.—Hypersound Aerodyn. Jul. 1967 p 125–156 refs In GERMAN; ENGLISH summary (See N68-13908 05-01)

The measurements reported elsewhere are used to discuss the flow field near the leading edge of a cooled flat plate in some regimes of hypersonic rarefied flow. The meaning of the viscous interaction parameter $\bar{V}_{\infty,x}=M_\infty\,(c_\infty/Re_{\infty,x})^{1/2}$ is explained. A division of the rarefaction regimes is deduced from the newest investigations. Author

N68-13982 Wissenschaftliche Gesellschaft fuer Luft- und Raumfahrt, Brunswick (West Germany).

MEETING REPORT OF THE WGLR TECHNICAL COMMITTEE ON AERODYNAMICS–WING AERODYNAMICS AND V/STOL AIRCRAFTS [BERICHT UEBER DIE SITZUNG DES WGLR-FACHAUSSCHUSSES AERODYNAMIK–TRAGFLUEGELAERODYNAMIK UND V/STOL-FLUGZEUGE]

21 Jul. 1967 90 p refs In GERMAN Meeting held at Munich, 8 Dec. 1966

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N68-13983 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

ON AERODYNAMIC AND FLIGHT MECHANICS EVALUATION OF RECOVERABLE HIGH ALTITUDE RESEARCH ROCKETS (PROJECT 621) [UEBER DIE FLUGMECHANISCHE UND AERODYNAMISCHE AUSLEGUNG DER RUECKFUEHRBAREN HOEHENFORSCHUNGSRAKETE PROJEKT 621 IM NATIONALEN RAUMFAHRTPROGRAM]

G. Harms et al *In* WGLR Meeting Rept. of the WGLR Tech. Comm. on Aerodyn. 21 Jul. 1967 p 12–40 refs Supported in part by BMWF (See N68-13982 05-01)

Design parameter development for a recoverable atmospheric sounding rocket centered on the aerodynamic evaluation of a flexible parawing model with nominal resistance during ascent and maximal drag during descent. Wind tunnel experiments and free flight measurements on a rocket-parawing model established maximal lift-drag ratios at subsonic velocities at Ma = 1.3, and at supersonic velocities at Ma = 3.5. Descent trajectories from initial start at 80 km reached maximal velocities comparable to Ma = 2.6 at a pressure of 330 kp/m^2. Measured values from free flight model tests showed good agreement with theoretically obtained results. Transl. by G.G.

N68-13984 Aerodynamische Versuchsanstalt, Gottingen (West Germany).

THE INFLUENCE OF A PROPELLER SLIP STREAM WAKE ON A RECTANGULAR WING WITH BOUNDARY LAYER INFLUENCE DUE TO EXHAUST OVER FLAP-NOZZLE [DER EINFLUSS EINES LUFTSCHRAUBENSTRAHLS AUF EINEN RECHTECKFLUEGEL MIT GRENZSCHICHTBEEINFLUSSUNG DURCH AUSBLASEN UEBER DER KLAPPENNASE]

R. Wulf et al *In* WGLR Meeting Rept. of the WGLR Tech. Comm. on Aerodyn. 21 Jul. 1967 p 41–68 refs (See N68-13982 05-01)

Interference effects of ejected air jets over the flap nozzle that are directed by the flaps towards the boundary layer on a rectangular airfoil were studied on wind tunnel models. Aerodynamic measurements found a linear lift augmentation with increased blowing force on the boundary layer. Even at small flap depths and large propeller diameters were good lifting effects obtained. Aerodynamic lift augmentation was only limited by the flap angle and when blow velocity reached acoustic properties. Transl. by G.G.

N68-14004# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).

ANALYSIS OF AERODYNAMIC DATA OBTAINED DURING ELDO F-5 FLIGHT

W. B. de Wolf 15 Sep. 1967 31 p refs Prepared for ELDO

(NLR-G-62) CFSTI: HC $3.00/MF $0.65

During the ELDO F-5 flight trial a number of pressures has been measured on the nose fairings of the vehicle. This report presents the flight conditions (Mach number, dynamic pressure, angles of incidence, sideslip and total angle of incidence) and pressure distributions on the nose fairings as obtained from these measurements. The flight conditions, thus obtained, are compared with calculations from trajectory, meteorological and vehicle attitude data. Mach number and dynamic pressure, as obtained from both methods, show very good agreement. Pressure distributions are compared with wind tunnel results, showing reasonable agreement. The total angles of incidence obtained from both methods show differences of up 2 degrees or more. Author (ESRO)

N68-14015# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).

ANALYSIS OF AERODYNAMIC DATA OBTAINED DURING ELDO F-4 FLIGHT

W. B. de Wolf 27 Jun. 1967 40 p refs Prepared for ELDO

(NLR-G-57) CFSTI: HC $3.00/MF $0.65

During the ELDO F-4 flight trial a number of pressures has been measured on the vehicle. In the present report the flight conditions are presented (Mach number, ambient static pressure, dynamic pressure, angles of incidence, sideslip and total angle of incidence) and pressure distributions along the vehicle as obtained from these measurements. The flight conditions, thus obtained, are compared with calculations from trajectory, meteorological and vehicle attitude data. Pressure distributions are compared with windtunnel results showing reasonable agreement. It is shown that it is impossible to determine normal force and bending moment to an acceptable degree of accuracy from the pressure distributions, because of the inaccuracy of the measurements and because of the fact that the number of orifices was too limited. Author (ESRO)

N68-14085# Weapons Research Establishment, Salisbury (Australia).
STARTING LOADS IN SUPERSONIC WIND TUNNELS AND SOME METHODS FOR THEIR ALLEVIATION
M. L. Robinson and E. R. A. Landers May 1967 70 p refs
(WRE-HSA-22)

Observations of starting flows and measurements of starting loads on a cone-cylinder model were made in an intermittent wind tunnel at Mach numbers 2.8, 4.0 and 5.0. It was shown that the starting flow configuration is determined basically by free interaction separation of the nozzle or side wall boundary layers, and on this hypothesis a physical picture of the starting flow has been deduced. A method of estimating starting loads based on the separated flow concept is presented and used to predict the loading encountered by a model mounted in a two dimensional wind tunnel nozzle. For the cone-cylinder model investigated agreement between theory and experiment was obtained for a range of conditions. The peak dynamic load experienced by the model support is dependent on the velocity of the starting shock wave system over the model, and a method is described whereby a measure of control of this velocity can be obtained. Under certain conditions a quasi-conical separated flow occurred about the cone-cylinder during the tunnel stopping phase. Investigation of this flow led to a method of producing symmetrical stopping flow configurations with resultant small model loads. Author

N68-14566 National Physical Lab., Teddington (England).
TECHNIQUES FOR THE MEASUREMENT OF AERODYNAMIC DERIVATIVES IN A WIND TUNNEL [TECHNIQUES DE MESURE DES DERIVEES AERODYNAMIQUES EN SOUFFLERIE]
J. B. Bratt *In* ONERA Aeroelasticity Manual, Vol. 4 [1967] 78 p refs (See N68-14561 05-32)

The fundamental problems inherent in determining aerodynamic characteristics in wind tunnel tests are discussed, and the principal techniques used are assessed. These include free and supported movement, and the measurement of such reactions as free oscillations, internal and external excitation, interrelated electrical oscillations, and pressure. These various techniques are analyzed, and the instruments for measuring displacement, force, pressure, amplitude, phase, and frequencies are described. A reference bibliography is included. Transl. by M.G.J.

N68-14645* Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
SOME RESULTS OF AN EXPERIMENTAL INVESTIGATION OF PLANE COMPRESSOR CASCADES WITH SMALL-ASPECT BLADES [NEKOTORYE REZUL'TATY OPYTNOGO ISSLEDOVANIYA PLOSKIKH KOMPRESSORNYKH RESHETOK S LOPATKAMI MALOGO UDLINENIYA]
A. Ye. Polyakov and Yu. V. Stepanov Dec. 1967 5 p refs Transl. into ENGLISH from the Publ. "Samoletostroyeniye i Tekhnika Vozdushnogo Flota" Khar'kov, State Univ. Press, 1966 p 28–31
(Contract NASw-1692)
(NASA-TT-F-11438) CFSTI: $3.00 CSCL 01A

Analysis of experimental data, showing that the characteristics of the mean cross-sections of small-aspect blades differ from those of large-aspect blades. Graphs showing the effect of the aspect ratio of blades and the nonuniformity of the incident flow on the outlet blade angle indicate that, for constant flow nonuniformity, the outlet blade angle remains constant in the region of its largest values and diminishes in the middle portion of the blades with increasing aspect ratio. The change in outlet blade angle at the mean vertical blade cross-section with a change in aspect ratio is attributed to the presence of vorticity which, in the case of small-aspect ratios, extends over the entire blade cavity. An increase in the nonuniformity of the velocity field at the cascade inlet leads to an increase in the outlet angle over the entire blade. Author

N68-14747*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
COMPUTER PROGRAM FOR DESIGN OF TWO DIMENSIONAL SUPERSONIC NOZZLE WITH SHARP EDGED THROAT
Michael R. Vanco and Louis J. Goldman Washington Jan. 1968 19 p refs
(NASA-TM-X-1502) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The FORTRAN IV computer program for the design of a two-dimensional supersonic nozzle with a sharp-edged throat is presented along with the equations used. The nozzle, which has uniform parallel flow at the exit, is designed on the basis of two-dimensional isentropic flow of a perfect gas. The program requires as input the exit Mach number and the specific-heat ratio. The output yields the nozzle contour for the supersonic portion. Input and output for a sample case are included. Author

N68-14912 Commissariat a l'Energie Atomique, Gramat (France).
DETERMINING THE GRUNEISEN COEFFICIENT AS A FUNCTION OF SPECIFIC VOLUME BY THE STUDY OF THE MACH NUMBER REFLECTION PHENOMENON [DETERMINATION DU COEFFICIENT DE GRUNEISEN EN FONCTION DU VOLUME SPECIFIQUE PAR L'ETUDE DU PHENOMENE DE REFLEXION DE MACH]
J. Leygonie and J. Cl. Bergon 15 Sep. 1967 7 p refs In FRENCH Presented at High Dyn. Pressure Symp., Paris, 11–15 Sep. 1967

Mach number intersection is determined in the domain usually considered as singular, and values for the Gruneisen coefficient obtained from the study of Mach number reflection are in agreement with previous results. Only dense metallic media were studied, and results are tabulated for two alloys designated Laiton UZ 36 and Ural AU4G. Transl. by M.W.R.

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-13985 Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
JET PROBLEMS WITH V/STOL AIRCRAFTS [STRAHLPROBLEME BEI SENKRECHTSTARTERN]
J. Barche et al *In* WGLR Meeting Rept. of the WGLR Tech. Comm. on Aerodyn. 21 Jul. 1967 p 73–90 refs (See N68-13982 05-01)

Aerodynamic interference effects of jet lift systems on V/STOL aircraft during hovering and transition flight phases are attributed to: (1) the suction effect of numeral jets coming from a nozzle cluster so that they almost form a single jet; and (2) the additional flow velocity created by the jet lift during the transition flight with its downward pressure on the wing and on the lower lying rudder installations. Transl. by G.G.

N68-14043 Royal Canadian Air Force, Ottawa (Ontario). Materiel Lab.
LIGHTBULB ANALYSIS AS AN AID IN ACCIDENT INVESTIGATION

M. R. Lundgren 26 Sep. 1966 67 p refs
(Rept.-13/66)

Two types of light bulbs found in aircraft warning light systems were tested to determine if their filament profiles are characteristic of whether they were on or off when they receive a severe shock such as in an aircraft crash. All of the bulbs were submitted to a spectrum of tests covering eight "in service" factors which affect the condition of a bulb and its filament. Subsequently the bulbs were sectioned using techniques developed during the test program. Photographs of the bulbs tested were taken under projection microscopes and are presented in tabular form. These results were then applied to examine lightbulbs removed from a crashed aircraft in order to illustrate the potential of lightbulb analysis in aircraft accident investigation. The condition of the lightbulb filaments is dependent on whether they were on or off at the time they experience a severe shock. Author

N68-14048*# Northrop Corp., Hawthorne, Calif. Norair Div.
CONCEPTUAL DESIGN STUDY REPORT
Jul. 1967 48 p Revised
(Contract NAS1-6777)
(NASA-CR-66416; NOR-67-6R) CFSTI: $3.00/MF $0.65 CSCL 01C

This volume provides a summary review of data leading to the recommendation of a single modified-existing aircraft concept and a single new aircraft concept meeting the NASA mission requirement for a V/STOL jet operations research airplane. The report traces the comparison of new and modified concepts from a baseline family of vehicles at study initiation, to the final selection of a new and modified vehicle. During the comparison effort many side studies were conducted to assess the impact of various aircraft technical requirements on vehicle size and cost. Additionally, many vehicle subsystems were studied in sufficient preliminary detail to determine weight, volume, power requirements, and costs. The recommended vehicles are both powered by the J85-19 lift and lift/cruise engine. The new vehicle concept employs 7 lift and 2 lift/cruise engines during composite flight. Provisions are made for 8 lift engines (with two cruise engines) during direct-lift operation. The recommended modified concept is the USAF T-39A modified to accept 8 lift and 2 lift/cruise engines for composite flight and 10 lift engines during direct-lift operation. Author

N68-14089# Bolkow Entwicklungen K. G., Munich (West Germany).
STATISTICAL MECHANICS OF AIRBORNE VEHICLE MOTIONS [STATISTISCHE MECHANIK VON FLUGKOERPERBEWEGUNGEN]
Bertrand Weissenbach 7 Sep. 1966 13 p refs In GERMAN Presented at the Ann. Joint Meeting DGRR/WGLR, Bad Godesberg (W. Germany), Oct. 1966
(DGRR/WGLR Paper-66-052; FM-350-O) CFSTI: HC $3.00/MF $0.65

The motions of an airborne vehicle under the effect of disturbing influence can only be discerned statistically on an ideal flight path that can be constantly reproduced. Consideration of an appropriate ensemble of flight paths makes it possible to interpret the basic concepts of statistical mechanics (such as temperature, entropy and useful work) in such a general way that they can be transposed to the motion of an airborne vehicle. The addition of information as negative entropy results in the emergence also of new aspects of dealing with the guidance problems of airborne vehicles. Author (ESRO)

N68-14090* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEASUREMENTS OF GROUND EFFECT ON A LOW-ASPECT-RATIO OGEE-WING AIRPLANE MODEL AND CALCULATIONS OF LANDING-FLARE TRAJECTORIES
Vernard E. Lockwood and W. Pelham Phillips Washington Jan. 1968 39 p refs
(NASA-TN-D-4329) CFSTI: $3.00 CSCL 01B

An investigation has been made to determine the ground effect on a 0.15-scale model of a fighter-type airplane having an ogee-wing planform. The characteristics in close proximity to the ground were determined by utilizing the moving-belt facility of the Langley 300-MPH 7- by 10-foot tunnel with and without ground-plane boundary-layer removal. Trim characteristics were determined for the model with and without landing gear. An analytical study showing the effect of airplane size on landing trajectories is also included. No significant differences in the aerodynamic characteristics were indicated with ground-plane boundary layer present or removed. The increases in lift-curve slope and longitudinal stability and the reduction in induced drag usually encountered by an airplane entering ground effect were noted. A landing-flare motion analysis using the experimentally determined data has indicated the descent rate at touchdown for a large low-aspect-ratio wing airplane of the supersonic transport size would be less than for a small airplane during a constant pitch attitude approach due to the longer time spent in ground effect. The descent rates encountered at touchdown were excessive for normal operational landings. Author

N68-14244 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany).
HIGH SPEED ROTORCRAFT [SCHNELLHUBSCHRAUBER]
Mar. 1967 223 p refs In GERMAN; ENGLISH summary Meeting of Tech. Comm. on Rotary Wing Aircrafts and Rotors, Stuttgart, 2 Dec. 1966
(DLR-Mitt.-67-05)

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4. RESEARCH WORKS ON HIGH SPEED ROTORCRAFT AND THE CONCEPT OF RETRACTABLE ROTORS P. L. Michel p 157-178 (See N68-14248 05-02)
5. OPTIMIZATION OF DESIGN DATA OF JET ROTORCRAFT W. Goeller p 179-224 refs (See N68-14249 05-02)

N68-14245 Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
REVIEW OF SEVERAL TYPES OF HIGH SPEED ROTORCRAFT [UEBERSICHT UEBER DIE VERSCHIEDENEN ARTEN VON SCHNELLHUBSCHRAUBERN]
Chr. Fischer *In* Deutsche Forschungsanstalt fuer Luft- und Raumfahrt High Speed Rotorcraft Mar. 1967 p 7-55 (See N68-14244 05-02)

The advantages of rotary wing aircraft over other types of V/STOL aircraft are briefly pointed out. This is followed by a review of existing and projected types of helicopters with small auxiliary fixed wings and additional sources of horizontal thrust for greater speed. Also covered are helicopters with rotors arrested during horizontal flight, retractable rotors, tilting rotors, tilt wing aircraft, and high-performance rotary wings for attaining greater horizontal speed. Transl. by K.W.

N68-14246 Bolkow Entwicklungen K. G., Munich (West Germany).
PROBLEMS WITH UNLOADED ROTORS [PROBLEME DES ENTLASTETEN ROTORS]
G. Reichert and B. Muehlig-Versen *In* Deutsche Forschungsanstalt fuer Luft- und Raumfahrt High Speed Rotorcraft Mar. 1967 p 57–106 refs (See N68-14244 05-02)

Problems of rotary wing aerodynamics, vibration, flutter, stability, and control are graphically presented and discussed. Examined are operating ranges of rotary wings, autorotation, rotation control, the effects of auxiliary fixed wings, and stability and control problems of fixed wing–rotary wing combinations. The consequences of increased speed for aircraft weight and payload are pointed out.
Transl. by K.W.

N68-14247 Merckle Flugzeugwerke G.m.b.H., Oedheim/Wuertt. (West Germany).
WIND TUNNEL STUDY OF HIGH PROPELLER MODULUS [WINDKANALVERSUCHE BEI HOHEN FORTSCHRITTSGRADEN]
P. Richter *In* Deutsche Forschungsanstalt fuer Luft- und Raumfahrt High Speed Rotocraft Mar. 1967 p 107–155 refs (See N68-14244 05-02)

The control stability and methods for decreasing the load of high-speed rotary blades were studied in wind tunnel experiments. It was found that selection of the proper blade angle factors for rearward motion provides effective control even at very high speeds. The experimental results were evaluated in order to derive a base for the mathematical prediction of forces on high-speed rotary blades.
Transl. by K.W.

N68-14248 United Aircraft Corp., Stratford, Conn.
RESEARCH WORKS ON HIGH SPEED ROTORCRAFT AND THE CONCEPT OF RETRACTABLE ROTORS [FORSCHUNGSARBEITEN UEBER DEN HOCHGESCHWINDIGKEITSHUBSCHRAUBER UND DAS KONZEPT DES EINZIEHBAREN ROTORS]
P. L. Michel *In* Deutsche Forschungsanstalt fuer Luft- und Raumfahrt High Speed Rotorcraft Mar. 1967 p 157–178 (See N68-14244 04-02)

The characteristics of several operational, experimental, and proposed U.S. helicopters are discussed and compared in order to find means for improving speed and range without loss of hover flight capabilities.
Transl. by K.W.

N68-14249 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
OPTIMIZATION OF DESIGN DATA OF JET ROTORCRAFT
W. Goeller *In* Deutsche Forschungsanstalt fuer Luft- und Raumfahrt High Speed Rotorcraft Mar. 1967 p 179–224 refs (See N68-14244 05-02)

Discussed are the theoretical aspects of programming the design parameters of reaction jet helicopter blades for optimum performance. The theoretical considerations include thermodynamic, aerodynamic, and weight factors. Results are also presented of parametric optimization calculations for variations in rotor data, blade angles, and thermodynamic values. Cold, hot, and mixed jet cycle propulsion systems are compared.
Transl. by K.W.

N68-14285* National Aeronautics and Space Administration, Washington, D. C.
DOES VARIABLE GEOMETRY OPEN THE DOOR TO POLYVALENCE [LA GEOMETRIE VARIABLE OUVRE-T-ELLE LA PORTE A LA POLYVALENCE]
Nov. 1967 30 p Transl. into ENGLISH from Forces Aeriennes Franc. (France), v. 21, Jun. 1967 p 859–895
(NASA-TT-F-11318) CFSTI: $3.00 CSCL 01C

The possibilities of using wings of variable geometry in the transonic and supersonic region are discussed on the basis of present-day French and American proto-types. Individual advantages and disadvantages of variable-sweep designs for various types of missions or phases of flight are reviewed, including low-altitude penetration, supersonic interception, escort missions, and takeoff and landing characteristics. The mechanics of the tilt-wing design are discussed with respect to its usefulness for a universal type of aircraft for all branches of service. The unavoidable necessity of a compromise between perfect adaptation to low altitude and perfect adaptation to high supersonic speeds is emphasized. Formulas are derived for determining applicability of variable sweep to different phases of flight.
Author

N68-14502# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Systems Engineering Group.
DEVELOPMENT OF IMPROVED GUST LOAD CRITERIA FOR UNITED STATES AIR FORCE AIRCRAFT Final Report, Jan.-Jun. 1967
William H. Austin, Jr. Sep. 1967 22 p refs
(SEG-TR-67-28; AD-662598)

Gust loads criteria were developed which represent a considerable improvement over the current discrete gust criteria. These new criteria are based on the strength level of previously successful aircraft, and result from a probabilistic assessment of expected gust loads. To supplement the probabilistic criteria, an arbitrary criterion for limit design gust velocity is presented. The analyses to be used in conjunction with the new criteria are based on the continuous turbulence concept which allows the realistic determination of aircraft loads in atmospheric turbulence.
Author (TAB)

N68-14574 Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
FINANCIAL, COMMERCIAL, AND TECHNICAL ASPECTS OF THE SUBORBITAL, ARC-ORBITAL, AND JET-ORBITAL TRANSPORT
R. J. Gunkel and W. H. Siegfried 1967 87 p refs Presented at 15th Intern. Congr. of Commun., Genoa, 12–15 Oct. 1967
(Douglas Paper-4668)

Additional refinement in atmospheric cruise and hybrid combinations of both space and atmospheric technologies to produce possible arc-orbital systems are described. Typical present and projected systems and the technological advances which must be accomplished are presented. An overall picture is given of cost distribution and necessary economic thresholds which must be crossed before commercial use of space and development beyond the supersonic transport and so-called subsonic jumbo-jet can be attained. Future commercial ventures are depicted and the transportation operating techniques, regulatory considerations, and airway and ground facilities are briefly described.
Author

N68-14633*# Rutgers Univ., New Brunswick, N. J. Center for Transportation Studies.
AN ANALYSIS AND SIMULATION OF LANDINGS UTILIZING STORED-ENERGY LIFT Final Report, May 12–Nov. 30, 1967
D. R. Ellis and E. Seckel 30 Dec. 1967 60 p refs
(Contract NSR-31-004-022)
(NASA-CR-91662) CFSTI: HC $3.00/MF $0.65 CSCL 01B

The various phases of a landing, in which energy stored on board the aircraft is used to support its weight during deceleration from flare to hover, are considered. The deceleration is assumed to be done at constant altitude and pitch attitude, lift due to stored energy being commanded as required by a seperate control at the lefthand of the pilot. Simulation of the deceleration phase of the landing was provided in a simple analogue computer, oscilloscope display, stick and lift control, arrangement. Variation of velocity and

various aerodynamic parameters with time were programmed in accordance with theoretical calculations of constant attitude deceleration with reverse thrust. Simulated deceleration and touch-down runs were made with various initial conditions and airplane parameters. Simulation of the landing procedure indicates that it is much more efficient to use stored-energy lift only as needed during deceleration, to support the aircraft as aerodynamic lift decreases. Estimates of stored-energy requirements are made for the various techniques and ranges of parameters. Author

N68-14735# Litton Systems, Inc., Woodland Hills, Calif. Guidance and Control Systems Div.
INTEGRATED COCKPIT RESEARCH PROGRAM, VOLUME 2 Final Report
John V. Murphy, Donald J. Pizzicara, James J. Belcher, Robert L. Hamson, and Raymond E. Bernberg Jan. 1967 231 p refs
(Contract Nonr-4951(00))
(AD-662186)

The program was designed to develop a methodology for avionic system design application to aircraft in an advanced time period. Emphasis was placed on two major activities. One was concerned with identifying the requirements for the operator/avionic system in the future time period, and a second activity was concerned with identifying the technological state-of-the-art that would be available in the advanced time period to meet those requirements. Successive aspects of the study were concerned with synthesizing an avionic system, completing a cost/effectiveness evaluation, and the preparation of a cockpit mockup. Volume II describes the application/results of the developed methodology for avionic system design in a V/STOL aircraft for an advanced time period. Author (TAB)

N68-14885 Brussels Univ. (Belgium). Institut d'Aeronautique.
EXPERIMENTAL GROUND EFFECT VEHICLE PV-1 [VEHICULE EXPERIMENTAL A COUSSIN D'AIR PV-1, RAPPORT DE SYNTHESE]
A. Jaumotte, A. Kiedrzynski, and M. Lejeune 1967 17 p refs In FRENCH
(Contract DRME-65/34)
(NT-15-1967; Rept.-7) CFSTI: $3.00

Results are synthesized for the construction of an experimental ground effect machine, PV-1; and experiences are included for the ground effect domain produced by a peripheral jet flow. Research is reviewed for the aerodynamics of ground effects, stability, propulsion, free flight, and flight above the water. Stability during pitch and roll is discussed, and controlling and piloting during free flight are considered. Transl. by M.W.R.

N68-14886 Brussels Univ. (Belgium).
EXPERIMENTAL GROUND EFFECT VEHICLE PV-1. STUDY OF USE ON WATER [VEHICULE EXPERIMENTAL A COUSSIN D'AIR PV-1. ESSAIS EN VOL SUR L'EAU]
A. Jaumotte, A. Kiedrzynski, M. Lejeune, and G. Van de Steen 1967 30 p refs In FRENCH
(Contract DRME-65-34079-00-480-75-01)
(NT-13-1967; Rept.-6; DRME-79-65)

Flight tests on the water are described for an experimental ground effect vehicle designated PV-1. Static tests at low speeds are reported, along with towing speeds on the order of 30 km/hr, a speed which is greater than the hump speed of the vehicle. The latter tests permitted the observation of the vehicle from static to normal functioning, and the determination of maximum resistance at various speeds. Wave and hydrodynamic resistances were measured, and resistance due to the water and to the spraying on the vehicle body were determined. Transl. by M.W.R.

N68-14903* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF PAVEMENT TEXTURE ON WET-RUNWAY BRAKING PERFORMANCE
Trafford J. W. Leland, Thomas J. Yager, and Upshur T. Joyner Washington Jan. 1968 37 p refs
(NASA-TN-D-4323) CFSTI: $3.00 CSCL 01B

An extensive test program was conducted at the Langley landing-loads track to investigate the effect on braking of tire tread pattern and tread materials for a variety of runway surfaces. Some of the tire test results were excerpted from this program and are presented to show the importance of runway surface texture in determining braking friction coefficient levels on wet runways. A technique for measuring the average texture depth of a given surface is suggested, and a limited correlation is shown between the texture depth measurements of four runway surfaces and the average friction coefficients developed by a smooth tire when braking on these wet surfaces. Surface wear due to traffic and weathering is shown to have a marked influence on the braking friction coefficient levels attained on wet runways. Author

N68-14939# Army Aviation Materiel Labs., Fort Eustis, Va.
XV-5A: MAINTENANCE AND SYSTEMS EVALUATION
Robert K. Massie Jul. 1967 187 p
(USAAVLABS-TR-67-53; AD-662715)

The data compiled during this evaluation were used to determine the effectiveness of design as it applies to maintainability of the overall aircraft, its systems, and its subsystems and, in cases of deficiencies, to recommend improvements and to specify areas that require further research before derivative XV-5A-type aircraft are constructed. Each problem area was analyzed to determine whether the discrepancies resulted from the austere research aircraft program or whether they were inherent in the lift-fan concept. Results of this study uncovered the desirable and undesirable features of 10 of the XV-5A aircraft systems. Design refinements that will be required to build the lift-fan concept into an operational model are not beyond the engineering technology available during the 1967-1971 time period. Author (TAB)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-14031# Royal Aircraft Establishment, Farnborough (England).
LARGE SOLAR CELL ARRAYS
F. C. Treble [1967] 37 p refs Presented at the ELDO Symp. on Propulsion, Paris, 10–12 Oct. 1967
CFSTI: HC $3.00/MF $0.65

The state-of-the-art and development prospects of solar cells are reviewed. It is shown that thin single-crystal silicon cells offer the best hope of meeting requirements for the construction of large deployable arrays in the next few years. Possible methods of stowage, deployment and support are described and estimates of specific weight and area are presented for a typical case. Using 100 gm thick n-on-p silicon cells of current performance, arrays weighing less than 20 kg per kW and extending about 12 m^2 per kW appear to be attainable. Concludes with a discussion of some of the problems to be overcome in the development, manufacture and testing of large arrays. Author (ESRO)

N68-14082*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF GREEN LIGHT ON SPECTRAL RESPONSE OF CUPROUS SULFIDE–CADMIUM SULFIDE PHOTOVOLTAIC CELLS

Andrew E. Potter, Jr., William B. Berry (Notre Dame Univ.), Henry W. Brandhorst, Jr., and Rose L. Schalla Washington Jan. 1968 12 p refs

(NASA-TN-D-4333) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Cadmium sulfide (CdS) solar cells consist of an evaporated layer on n-type CdS covered with a thin film of p-type cuprous sulfide (Cu_2S). The response of these cells to red light increases on exposure to green light. The absolute quantum yield of a single-crystal CdS cell was measured under various conditions to aid in understanding this effect. Before heat treatment, the quantum yield was not affected at all by green light. After heat treatment, the quantum yield in the red part of the response spectrum was greatly reduced, but green light restored it to nearly its value before the heat treatment. In another experiment, the current-voltage characteristic of a CdS film cell was measured under red and white light. Analysis of the characteristic curves showed the series resistance of the cell in red light to be 2 orders of magnitude larger than that in white light. These results were interpreted as follows: Heat treatment causes copper to diffuse into the CdS, which produces a layer of copper-compensated CdS having a high dark resistance. This layer is highly photoconductive. Its resistance is greatly lowered by green light but only slightly by red light. Consequently, under red light, the current from the cell is limited by a high series resistance. Under green light, this limit is removed, and the sensitivity of the cell to red light is increased. Author

N68-14182# Los Alamos Scientific Lab., N. Mex.

AN IMPROVED MOLTEN SALT EMF CELL. STUDIES USING $SnCl_2$ AND TIN ALLOYED WITH Cu, Ag, OR Au TO TEST FOR RAOULT'S LAW BEHAVIOR

G. R. B. Elliott and J. F. Lemons 16 Oct. 1967 8 p refs

(Contract W-7405-ENG-36)

(LA-3733) CFSTI: HC $3.00/MF $0.65

An H-cell was designed to provide for stirring and solute addition in a sealed, isolated, and heated system. Measurements at 535°K were made using dilute solute, X, and cells of the type: $W–Sn_{(l)}/SnCl_{2(l)}/Sn.\ X_{(Soln)}–W$. The cell voltages were constant at any time to a few tenths of a microvolt with day-to-day variations generally less than 1 μv. Unlike many precise vapor pressure measurements that failed to indicate approach to the slope of Raoult's law in similar composition regions, these measurements for copper, silver, and gold solutions lie very close to Raoult's law at their dilute limit. For tin with silver, the data deviate from Raoult's law by following a term in the square of the solute mole fraction; with gold, the deviations are more complex and are interpreted in terms of solution structure. Possible inaccuracies in thermodynamics prediction are discussed. Author (NSA)

N68-14185* Electro-Optical Systems, Inc., Pasadena, Calif.

PLANETARY SOLAR ARRAY DEVELOPMENT Quarterly Report

R. Wizenick 6 Jan. 1968 73 p Prepared for JPL

(Contracts NAS7-100; JPL-952035)

(NASA-CR-91730; EOS-7254-Q-2) CFSTI: $3.00 CSCL 10A

Conceptual designs of photovoltaic solar arrays capable of producing 200 watts of raw electrical power on the Martian surface at solar noon are described. The following four concepts are evaluated: (1) deployable fixed array; (2) two axis, two panel array mounted from two opposing sides of the spacecraft with one common horizontal boom; (3) two axis, one panel array mounted on a single vertical boom together with the antenna; and (4) two axis two panel array mounted on a single vertical boom together with the antenna. Conceptual drawings of the candidate arrays are included. Solar circuit design, substrate design, and materials studies which provided a common basis for the concepts chosen for detail design studies are also examined. S.C.W.

N68-14541# California Univ., Livermore. Lawrence Radiation Lab.

FLUX-COMPRESSION GENERATORS

E. I. Bichenkov Sep. 1967 12 p refs Transl. into ENGLISH Akad. Nauk SSSR (Moscow), v. 174, no. 4, 1967 p 779–782

(UCRL-TRANS-10133) CFSTI: HC $3.00/MF $0.65

The results of work done at Hydrodynamics Institute of the Siberian Division of the USSR Academy of Sciences on the construction of explosion devices converting the energy of the explosives into the energy of a magnetic field are summarized. Several methods are described. NSA

N68-14630* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PARAMETRIC ANALYSIS OF RADIOISOTOPE-THERMOELECTRIC GENERATORS

James J. Ward, William J. Bifeno, and Larry S. Blair Washington Oct. 1967 22 p ref

(NASA-TM-X-1453) CFSTI: $3.00 CSCL 10B

A parametric analysis of a radioisotope-thermoelectric power generator is presented. A cylindrical heat-source geometry was assumed with either lead telluride or silicon-germanium thermoelectric elements located around the lateral surface of the fuel block. The heat source was treated parametrically by using the effective-volume power density of the heat source as a variable. Generator efficiency and specific weight were determined for fuel-block length-to-diameter ratios from 0.5 to 10.0, effective-volume power densities from 0.5 to 10.0 watts per cubic centimeter (W/cc), thermoelectric element hot-junction temperatures of 811°K for lead telluride and 1089° and 1255°K for silicon-germanium, and generator electrical output powers from 100 to 1000 watts. The results indicate that a substantial specific weight advantage is gained by employing silicon-germanium thermoelectric elements rather than lead telluride. In all cases, however, minimum specific weight is achieved at the lowest output power level, that is, 100 watts electric (W_e). For silicon-germanium generators having an output power of 100 W_e, the minimum specific weights are 120 and 88 lb/kW_e (54.5 and 40 kg/kW_e) for hot-junction temperatures of 1089° and 1255°K, respectively, with corresponding generator efficiencies of 4.1 and 5.8 percent. Author

N68-14839*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE EVALUATION OF A TWO STAGE AXIAL-FLOW TURBINE FOR TWO VALUES OF TIP CLEARANCE

Milton G. Kofskey and William J. Nusbaum Washington Jan. 1968 20 p refs

(NASA-TN-D-4388) CFSTI: HC $3.00/MF $0.65 CSCL 10A

An experimental investigation was made of a two-stage turbine designed to drive an alternator for a 10-kilowatt-shaft-output space power system. Performance results were obtained for the turbine operating with the rotor tip clearance of 0.031 inch (0.079 cm) recommended for preliminary hot operation of the turbine. These results are compared with the results obtained with the design tip clearance of 0.013 inch (0.033 cm). Tests were made with cold argon as the working fluid over a speed range from 0 to 120 percent of design equivalent speed and at pressure ratios ranging from 1.08 to 1.55. The results of the investigation indicated that the static and total efficiencies were 0.785 and 0.792, respectively, for a tip clearance of 0.031 inch (0.079 cm). These values represent a 4-percentage-point decrease in turbine efficiency when the tip clearance is increased. The results based on

two tip clearances indicated that the subject turbine, which was designed with high rotor reaction, was very sensitive to changes in tip clearance. There was a 3.7-percent decrease in turbine specific work for an increase in tip clearance of 1.0 percent of passage height. This decrease is substantially greater than the 1.75-percent decrease in turbine work obtained for a reference turbine of impulse design. Author

N68-14784* Battelle Memorial Inst., Columbus, Ohio.
A WATER-VAPOR ELECTROLYSIS CELL WITH PHOSPHORIC ACID ELECTROLYTE
J. E. Clifford, A. C. Secreist, J. T. Gates, and C. L. Faust Sep. 1966 68 p refs
(Contract NAS2-2156)
(NASA-CR-73170) CFSTI: HC $3.00 CSCL 10C

The chronological development program that led to the design and fabrication of a water-vapor electrolysis cell module with integral ducting and fan is described. When such a vapor cell operates on recirculated spacecraft cabin air, dehumidification and oxygen generation occur simultaneously and many factors control the ultimate performance. The expected performance characteristics of this module, a battery of 12 electrolysis units of two cells connected in parallel, were verified in extended testing of laboratory models and experimental cells. These tests led to the design of a unit weighing 4.2 lbs with 2.2 ft^2 of electrolysis area, and a predicted oxygen capacity of 2/3 lb per day at 28 volts and 2 lbs per day at 32 volts. The derivation of equations for estimating aerosol concentration from indicator paper tests is appended. E.J.S.

N68-14818* National Aeronautics and Space Administration, Washington, D. C.
ELECTROCHEMICAL SPACE POWER SOURCES
Ernst M. Cohn 1967 122 p refs Presented at the AGARD/NATO Lecture Series, Brussels, Belgium, 2-5 October 1967
(NASA-TM-X-60795) CFSTI: $3.00 CSCL 10B

After a general discussion of electrochemical energy storage and electricity generation in aerospace, the thermodynamic and kinetic electrochemical basis for these devices, as well as criteria for selecting electrochemically active materials and estimating energy densities are presented. The following three sections cover primary and secondary equipment, either now being used or of potential usefulness in space. The last two sections relate some design criteria for space power systems and consider possible earth-bound applications of space-oriented electrochemical research and development. Author

N68-14891# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).
CHANGE OF ELECTRICAL PROPERTIES OF SI SOLAR-CELLS BY NEUTRON IRRADIATION [AENDERUNG DER ELEKTRISCHEN EIGENSCHAFTEN VON SI SOLARZELLEN DURCH NEUTRONEN BESTRAHLUNG]
B. Reinicke and K. Zander Jul. 1967 40 p refs In GERMAN
(HMI-B-60)

The influence of fast neutrons on p-n-Si-solarcells is discussed. For tungstenlight (T_V=2854°K) it was investigated: current-voltage-characteristics, efficiency, short circuit and open circuit voltage as function of the irradiation. By means of spectral photosensitivity one can calculate the quantum efficiency. To explain values greater than unit (<1.25) one has to assume the existence of electrical fields in the base region. The strength of this field is calculated by an improved diffusion model. The damage factor of the diffusion length is evaluated and compared with those of literature. Author (NSA)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-13920 Joint Publications Research Service, Washington, D. C.
A SPIRAL DESIGN FOR SPACE-STATION GREENHOUSES
V. G. Chuchkin 10 Jan. 1968 24 p refs Transl. into ENGLISH from Priroda (Moscow), no. 10, 1967 p 58-69
(JPRS-43943)

Various types of spacecraft greenhouses are discussed in terms of obtaining the maximum increase in plant productivity with the most economical expenditure of light energy. Equations are derived for calculating the quantity of radiant energy required, the planting area, and the coefficients of absorption and conversion of radiant energy. To achieve maximum light absorption, a method is proposed whereby the planted area is divided into gradually increasing sectors with the plants moved each day from smaller areas to larger. Three necessary conditions can then be combined into a single garden: constant leaf index, constant size of planted area, and daily harvesting. The technical difficulties of automating this method for cosmic greenhouses are assessed, and variants of the spiral-radial planting concept are discussed. It is pointed out that the development of such a technique will allow the operating regime of the greenhouse to be rapidly altered, and will permit transition from vitamin to carbohydrate plant growth in order to change the rations of the space crews. M.G.J.

N68-13947*# Miami Valley Hospital, Dayton, Ohio. Dept. of Research.
THE BIOCHEMICAL, PHYSIOLOGICAL, AND METABOLIC EVALUATION OF HUMAN SUBJECTS WEARING PRESSURE SUITS AND ON A DIET OF PRECOOKED FREEZE DEHYDRATED FOODS
Bernard J. Ketchman, George M. Homer, and Dorathea P. Dunco Wright-Patterson AFB, Ohio AMRL Jun. 1967 61 p refs Prepared jointly with AMRL
(NASA Order R-85; Contract AF 33(657)-11716)
(NASA-CR-91680; AMRL-TR-67-8) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Eight human male volunteers participated in two 6-week simulated aerospace studies. During this time the subjects wore an unpressurized MA-10 pressure suit for 18 consecutive days and ate a 4-day cycle diet composed of precooked freeze dehydrated foods or a matched 4-day cycle diet composed of fresh foods. The food was served at room temperature. Each diet was comprised of about 330 g of carbohydrate, 95 g of crude protein, 87 g of fat, and 2500 kcal per day. The diets were organoleptically acceptable and efficiently utilized. Only minimal weight changes were observed. Metabolic balances showed adequate adjustment to the diets; all subjects were in positive balance for nitrogen and for the major inorganic constituents. The wearing of the MA-10 pressure suit did not affect protein or caloric requirements but water intake did increase significantly by 17%. There were no significant changes in blood pressure or oral temperature. All other clinical measurements were in the normal range of clinical values. All subjects maintained excellent health throughout all the test periods. Author

N68-13980*# Brandeis Univ., Waltham, Mass.
[A COMPARATIVE STUDY OF THE EVOLUTION OF ENZYMES AND NUCLEIC ACIDS] Semiannual Progress Report, 1 May-30 Nov. 1967

Nathan O. Kaplan, Lawrence Levine, and William S. Allison 20 Nov. 1967 5 p refs
(Grant NsG-375)
(NASA-CR-91672) CFSTI: HC $3.00/MF $0.65 CSCL 06A

The immunological approach is discussed, and it is reported that antibodies to a highly acid, brain-specific protein found in vertebrates (S-100 protein) were obtained with the purified bovine S-100 complexed with methylated bovine serum albumin as immunogen. The presence of antigenic activity in brain extracts from a number of vertebrates measured by a quantitative complement fixation technique indicated an unusually close serological relationship among these S-100 proteins. In the enzymological approach, experiments on the heterogeneity of the multiple forms of aldolase in chicken tissues demonstrated that a third parental type (aldolase C) occurs in chicken tissues along with its hybrid forms. Summary information is included on the purification of soluble aspartate aminotransferase from chicken hearts; the purification of arginine kinase from the lobster, blue crab, and the hermit crab; the amino acid sequence of dogfish M_4 lactate dehydrogenase (LDH); the physical properties of LDH from the tail muscle of the American lobster; and the behavior of pseudomonas mutant enzymes. M.G.J.

N68-14108*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
USE OF THE PIGTAIL MONKEY, *MACACA NEMESTRINA*, IN SPACE BIOSCIENCE STUDIES
J. W. Parcher 4 Oct. 1967 12 p Presented at 18th Ann. Meeting of Am. Assoc. for Animal Sci., Washington, D. C., 2–10 Oct. 1967
(NASA-TM-X-60822) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Project Biosatellite was established to study effects of space flight on a variety of living organisms. The study includes placing a *Macaca nemestrina* in orbit for a month. Physiological changes due to a 30-day period of weightlessness will be used to estimate the hazards to man of extended space flights planned for the near future. Colony management is designed to yield animals free of disease or other stress. Approximately 500 pigtail monkeys will be used in preliminary studies to establish a basis for evaluation of flight data. Early baseline data reveal the *Macaca nemestrina* is very similar to man in blood chemistry and serum enzyme levels. Hematological values, rate of growth, and responses to stress are comparable to those of humans of equivalent age. Author

N68-14126# Sloan-Kettering Inst. for Cancer Research, New York.
RADIATION STUDIES. 1: FREE RADICAL PRODUCTION IN BIOLOGICALLY SIGNIFICANT COMPOUNDS. 2: EXPERIMENTAL STUDY OF ELECTRON SPECTRA INSIDE IRRADIATED TISSUE FROM INTERNALLY LOCATED RADIONUCLIDES. 3: THEORETICAL INVESTIGATION OF ELECTRON LET SPECTRA AND DOSE RELATIONSHIP FOR IONIZING RADIATION Progress Report, May 1, 1966–May 1, 1967
John S. Laughlin, Ira S. Pullman, and Nikitas D. Kessaris 15 Aug 1967 10 p refs
(Contract AT(30-1)-910)
(NYO-910-57) CFSTI: HC $3.00/MF $0.65

Progress is reported on the following studies: protective mechanisms in X-irradiated systems of sulfhydryl compounds with nucleic acids; electron spin resonance spectroscopy of irradiated bone samples; studies on negative ions of polycyclic hydrocarbons; and ESR spectra of uv-irradiated purine N-oxides. NSA

N68-14208*# Bellcomm, Inc., Washington, D. C.
MEDICAL REQUIREMENTS IN SUPPORT OF LONG DURATION MANNED SPACE FLIGHT
D. B. Hoffman and A. N. Kontaratos 20 Nov. 1967 48 p refs
(Contract NASw-417)
(NASA-CR-91806; TR-67-710-1) CFSTI: HC $3.00/MF $0.65 CSCL 06S

The objective of this study is to suggest a broad medical program in support of advanced manned missions. Twelve factors which concern the general health and performance of the crew are examined; appropriate decisions necessary to prevent or rectify possible failures are established; engineering implications are discussed; and pertinent ground-based or in-flight studies are proposed. These factors include: weightlessness, radiation, meteoroids, extraterrestrial life, magnetic fields, habitability, atmospheric contaminants, mechanical forces, artificial atmosphere, nutrition, and medical care. From this analysis eleven major medical decisions were identified, their significance discussed and their implications reviewed. Finally, research activities were integrated into a program sequence and medical decisions were time phased to illustrate both the type of planning required and the extent of interoffice coordination needed to support a pacing goal. Author

N68-14221*# Sandia Corp., Albuquerque, N. Mex. Planetary Quarantine Dept.
[SCOPE OF WORK FOR SCIENTIFIC AND TECHNICAL ASSISTANCE FOR THE PLANETARY QUARANTINE MISSION] Quarterly Report, Period Ending 31 Dec. 1967
Dec. 1967 13 p refs
(NASA Order R-09-019-040; NASA Order H-13245A)
(NASA-CR-91668; QR-7) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Various activities being studied in spacecraft contamination control are outlined. These pertain to (1) sterilization model for microbial deactivation, (2) statistical estimates of space vehicle microbial burdens, (3) retrieval of terrestrial microorganisms from the lunar surface, (4) laminar flow clean rooms, and (5) contamination control principles and study. B.S.D.

N68-14258# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
A LOOK AT SIMULATION THROUGH A STUDY ON PLANKTON POPULATION DYNAMICS
C. R. Cole Aug. 1967 19 p ref
(Contract AT(45-1)-1830)
(BNWL-485) CFSTI: HC $3.00/MF $0.65

The annual cycle observed in the population dynamics of estuarine phytoplankton and zooplankton was simulated according to the model developed by Davidson and Clymer. This simulation demonstrated the usefulness of analog computer modeling in studying ecological systems. The report contains several examples in which the effect of parameter changes are predicted by the model. A typical result indicated that an increase in phytoplankton death rate increased the magnitude of the spring algal bloom. Results such as this, that contradict intuition, bring ecological mechanisms to light that might otherwise remain undiscovered. Author (NSA)

N68-14274*# Naval School of Aviation Medicine, Pensacola, Fla.
EFFECT OF HYPOXIA ON MYOCARDIUM IN HEART–LUNG PREPARATION
N. S. Nejad and Eric Ogden 13 Nov. 1967 14 p refs Prepared jointly with NASA
(NASA-CR-91678; NAMI-1024) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Starling heart-lung preparations were ventilated with various mixtures of oxygen, nitrogen, and carbon dioxide, and the performance of the heart was evaluated by relating stroke work to left atrial pressure. At oxygen tensions of arterial blood between 65 mm Hg and 25 mm Hg performance improved. At 20 mm Hg or lower the performance was impaired but the impairment was

reversible. The impairment was accompanied by an accumulation of lactate and pyruvate in the blood which also was reversible as oxygen tension was restored. Possible mechanism of these changes is discussed. Author

N68-14330*# Miami Valley Hospital, Dayton, Ohio. Dept. of Research.

THE POTENTIAL HAZARD OF STAPHYLOCOCCI AND MICROCOCCI TO HUMAN SUBJECTS IN A LIFE SUPPORT SYSTEMS EVALUATOR AND ON A DIET OF LIQUID FOODS

Leonard R. Lotter, Bonnie S. Horstman, and Joseph V. Rack Wright-Patterson AFB, Ohio AMRL Sep. 1967 43 p refs Prepared jointly with AMRL

(NASA Order R-85; Contract AF 33(657)-11716)

(NASA-CR-91678; AMRL-TR-67-21) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Two groups of 4 human male subjects participated in 6-week simulated aerospace studies. The subjects were confined and kept under controlled metabolic conditions; during this time, 28 consecutive days were spent in the Life Support Systems Evaluator. The subjects ate diets composed either of fresh food or liquid food. The subjects were exposed to simulated aerospace stress of confinement, (wearing an unpressurized MA-10 space suit), experimental diet, and minimal personal hygienic conditions. Body and environmental areas were sampled and the catalase-positive gram-positive cocci isolated were tested for production of coagulase, deoxyribonuclease, hemolysin, gelatinase, and utilization of mannitol. The results show that there were no significant differences in the frequency of occurrence of biochemical types among subjects and among environmental areas. There were significant differences in frequency of occurrence of biochemical types on ear, nose, throat, mouth, axilla, groin, and glans penis. There was no buildup of biochemical types with time in any test condition. Two phage types, UC-18 and 79, were recovered. Phage type UC-18 was transferred from subject to environment but not vice versa or among other subjects. Phage type 79 was not transferred at all. The subjects remained healthy without any decrease in resistance to infection throughout all test conditions. Those body areas most likely to harbor potentially pathogenic staphylococci are the ears and nose. Author

N68-14359# Florida Presbyterian Coll., St. Petersburg. Neuro-Sciences Lab.

BIOPHYSICS OF INTRACRANIAL SELF-STIMULATION Final Report, 1 Nov. 1966–31 Jul. 1967

W. F. Angermeier and Darryl Boyd Neill Holloman AFB, N. Mex. 6571st Aeromed. Res. Lab. Nov. 1967 53 p refs

(Contract F29600-67-C-0011)

(ARL-TR-67-25; AD-662617)

A self-stimulation and E-controlled stimulation study was completed in one rat. The study supports the two-factor model of the self-stimulation mechanism which predicts (1) the shape of self-stimulation curves and changes in stimulation rate as a function of stimulation parameters, (2) dual autonomic effects of self-stimulation, (3) stimulus-bound feeding and self-stimulation at the same electrode site, (4) on-off behavior, and (5) changes in the above with changes in anatomical locus. Author (TAB)

N68-14380 National Institutes of Health, Bethesda, Md. Translating Unit.

OPTICAL INVESTIGATIONS OF COMPLEXES AND NUCLEIC ACIDS AND DYES

V. I. Permogorov, L. A. Serdiukova, Iu. S. Lazurkin, and I. A. Sladkova 30 Nov. 1967 26 p refs Transl. into ENGLISH from the Publ. "Struktura, Svoistva i Geneticheskie Funktsii DNK", 1966 p 111–138 Presented at Conf. of the Radiobiol. Div. of the I. V. Kurchatov Inst. of Atomic Energy, Moscow, 8–11 Jun. 1966

(Rept.-11-32-67)

The anomalous optical rotatory dispersion (AORD) of pinacyanol (PNC) complexes with DNA has been studied. The dependence of AORD on the concentration and highly asymmetrical form of its curve permitted us to come to a conclusion, that PNC becomes optically active only when PNC dimeres are bound to the native DNA. The temperature dependence of amplitude of AORD PNC–DNA complexes also has been studied. It is demonstrated, that the magnitude of optical activity increases markedly with increasing temperature not far from the melting point and then decreases practically to zero, when DNA becomes wholly denatured. The cause of the increase of AORD is as follows: PNC is better bound to the native DNA, than to the denatured DNA, and in partially denatured DNA the dimerization increases. The form of the AORD curves is highly dependent on the conformation of the nucleic acids. The AORD was also observed in cases of formation of PNC–RNA and PNC—synthetic polynucleotides complexes. Author

N68-14500# School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.

VALIDITY OF THE HUMAN 17-HYDROXYCORTICOSTEROID/CREATININE RATIO Final Report, Apr. 1966–May 1967

Henry B. Hale and Ira L. Shannon Sep. 1967 6 p refs

(SAM-TR-67-89; AD-662609)

Short-term and long-term trends for urinary creatinine excretion rate, 17-hydroxycorticosteroid (17-OHCS) excretion rate, and the 17-OHCS/creatinine ratio were investigated, utilizing data obtained from 11 healthy men during forenoon and afternoon periods on 5 consecutive days in each of 4 consecutive weeks. Creatinine excretion rate did not show significant forenoon-afternoon variation, but there was forenoon-afternoon variation ($P < .01$) for both 17-OHCS excretion rate and the 17-OHCS/creatinine ratio, each declining as time proceeded. Using creatinine as the base for 17-OHCS did not cause distortion; instead, there was a statistical gain, as the variance was then lessened. Significant week-to-week variation was detected only in afternoon data, and it was limited to creatinine excretion rate ($P < .001$) and 17-OHCS excretion rate ($P < .01$), both declining progressively over the 4-week test period. Since the 17-OHCS/creatinine ratio did not show week-to-week variation, it was concluded that creatinine acted as a correction factor, eliminating the long-term variation in 17-OHCS. Author (TAB)

N68-14611# California Univ., Berkeley. Lawrence Radiation Lab.

OPTICAL PROPERTIES OF RIBONUCLEIC ACIDS PREDICTED FROM OLIGOMERS

C. R. Cantor, S. R. Jaskunas, and I. Tinoco, Jr. *In its* Chem. Biodyn. 1 May 1967 p 18–19 refs (See N68-14606 05-06)

In view of the complexity of the problem of RNA conformation, what is needed is a set of simple model systems. These are the oligoribonucleotides. We expect that most of the properties of RNA should eventually be explainable in terms of the properties of its smaller components. Towards this end we are studying the conformational properties of oligonucleotides. In this paper we shall use some of the results obtained with oligomers to analyze the properties of polymers. Here we shall be mostly concerned with ultraviolet optical properties. The major advantage of ultraviolet spectra and optical rotatory dispersion is that experiments can be performed with very small quantities of material. Thus there is available a wealth of experimental data. Author

N68-14612# California Univ., Berkeley. Lawrence Radiation Lab.

CHLOROPHYLL–CHLOROPHYLL INTERACTIONS

Edward A. Dratz, Alfred J. Schultz, and Kenneth Sauer *In its* Chem. Biodyn. 1 May 1967 p 20–30 refs (See N68-14606 05-06)

The circular dichronism and absorption spectra of dimers of chlorophylls A and B and bacteriochlorophyll in carbon tetrachloride solutions and of suspended crystalline chlorophyll A are presented. The dimers of all three chlorophylls seem to have a

very similar structure. The chlorophyll–chlorophyll interactions in the dimer give rise to very large optical activity relative to the monomer. The circular dischroism and absorption spectra of photosynthetic particles (barley quantesomes containing chlorophylls A and B, quantesomes prepared from a barley mutant that lacks chlorophyll B, and R rubrum and R spheroides chromatophores that contain bacteriochlorophyll) are also presented. Author

N68-14613# California Univ., Berkeley. Lawrence Radiation Lab.
FREEZE-ETCHING OF CHLOROPLASTS FROM GLUTARALDEHYDE-FIXED LEAVES
Roderic B. Park and Daniel Branton *In its* Chem. Biodyn. 1 May 1967 p 33–38 refs (See N68-14606 05-06)

Freeze-etching as a preparative technique for electron microscopy has been in use almost 12 years. Its initial application was to studies of virus morphology, but improvements in methodology have opened many new applications. The technique basically consists of rapidly freezing biological material and then breaking the frozen specimens in a vacuum. The surface so exposed is replicated, and the replica is observed by electron microscopy. The degree of etching is controlled by the time elapsed between breakage and replication and by the temperature of the specimen. Studies on chloroplast morphology by this technique have been reported by Muhlethaler, Moor, and Sarkowski and by Branton and Park. These two studies, although based on almost identical data, have produced very different interpretations. The major points of interpretive disagreement between the two studies are reviewed here, and some new data pertinent to the arguments are presented. Author

N68-14614# California Univ., Berkeley. Lawrence Radiation Lab.
PHOTOSYNTHESIS BY ISOLATED CHLOROPLASTS
R. G. Jensen and J. A. Bassham *In its* Chem. Biodyn. 1 May 1967 p 40–43 refs (See N68-14606 05-06)

Intact and freshly harvested and healthy spinach leaves gave a CO_2 fixation rate of 245 μmoles CO_2/mg Chl/hr. Chloroplasts prepared the same day from leaves from the same plants gave a fixation rate of 155 μmoles CO_2/mg Chl/hr. This rate with isolated chloroplasts was obtained over a period of 8 min following 3 min preillumination. Thus the isolated chloroplasts, for a limited period of time, assimilated carbon dioxide at a rate that was 63% of the in vivo photosynthetic rate. Author

N68-14615# California Univ., Berkeley. Lawrence Radiation Lab.
PHOTOSYNTHESIS BY ISOLATED CHLOROPLASTS. 2: DISTRIBUTION OF ^{14}C-LABELED PRODUCTS BETWEEN CHLOROPLASTS AND SUPERNATANT SOLUTION
J. A. Bassham, R. G. Jensen, and Martha Kirk *In its* Chem. Biodyn. 1 May 1967 p 44–48 refs (See N68-14606 05-06)

In these studies, chloroplasts were isolated from freshly grown spinach and then suspended in the usual assay medium. In the first experiment, after a period of 3 min preincubation, ^{14}C-labeled bicarbonate was added to the chloroplasts and, over a period of 40 min photosynthesis, samples were taken for analysis. In a second experiment, chloroplasts were isolated and preilluminated as just described. However, ^{32}P-labeled phosphate was added at the beginning of the preillumination period and ^{14}C-labeled bicarbonate was added after 4 min of preillumination with the radiophosphorus. One sample was taken just before the addition of $^{14}CO_2$, and other samples were taken periodically after the addition of bicarbonate. Author

N68-14616# California Univ., Berkeley. Lawrence Radiation Lab.
SEARCH FOR δ-AMINOLEVULINIC ACID AS A PRODUCT OF METHANE–AMMONIA–WATER IRRADIATION
Margaret A. Smith, Ahmed Choughuley, and Richard M. Lemmon *In its* Chem. Biodyn. 1 May 1967 p 77–79 refs (See N68-14606 05-06)

Our understanding of how the porphyrins may have appeared on the primitive, prebiotic Earth is still in an unsatisfactory state. It is generally assumed that they may have appeared abiogenetically following the now established biosynthetic route. That a similar route may have been followed on the prebiotic Earth is indicated by the recent work of Szutka in this Laboratory. He found that the ultraviolet irradiation of δ-ALA, under primitive Earth conditions, converted about half of this compound to a pyrrolic compound—the latter was not specifically identified. The question remains: is δ-ALA a product of CH_4–NH_3–H_2O irradiations? This report details our efforts, so far unsuccessful, to establish it as such a product. Author

N68-14671* National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY—A CONTINUING BIBLIOGRAPHY WITH INDEXES
Nov. 1967 172 p refs
(NASA-SP-7011(43)) CFSTI: $3.00 CSCL 06S

The abstracts and annotated indexes were selected from those introduced into the NASA Information System during October 1967. The references were previously announced by the Library of Congress, the American Institute of Aeronautics and Astronautics, and NASA. The emphasis is placed on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. N.E.N.

N68-14672 National Institutes of Health, Bethesda, Md.
TYPES OF VEGETATIVE SHIFTS IN MAN DURING EMOTIONAL STRESS
L. P. Grimak and V. A. Ponomarenko 1967 8 p refs Transl. into ENGLISH from Zh. Vysshei Nervnoi Deyatel'nosti (Moscow), v. 17, no. 3, 1967 p 406–412

The reactions of the cardiovascular and respiratory systems produced by negative emotions were studied in novice parachutists and also in experienced aviators under conditions of failures in the automatic control. The subjects were put under hypnosis and the jump or emergency situation was reproduced. Stenosis in the peripheral blood vessels was noticed in all individuals. Shifts in the minimal and maximal arterial pressure are described for the parachutists. The differences between the reactions of the experienced and those of the inexperienced men are discussed. N.E.N.

N68-14725* National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY—A CONTINUING BIBLIOGRAPHY WITH INDEXES
Oct. 1967 153 p refs
(NASA-SP-7011(42)) CFSTI: $3.00 CSCL 06S

The abstracts and indexes were selected from those introduced into the NASA Information System during September 1967. They appeared previously in the separate journals of the Library of Congress, the American Institute of Aeronautics and Astronautics, and NASA. The emphasis is placed on the biological, physiological, psychological, and environmental effect to which man is subjected during aerospace flight. N.E.N.

N68-14737*# Harvard Univ., Boston, Mass. Thorndike Memorial Lab.
A STUDY OF PHYSIOLOGICAL MECHANISMS AND INTER-RELATIONS BETWEEN SYSTEMIC AND REGIONAL BLOOD VOLUME, BLOOD FLOW AND ELECTROLYTE BALANCE Interim Progress Report, Jun. 30–Dec. 31, 1967

Walter H. Abelmann and Laurence E. Earley 31 Dec. 1967 6 p refs
(Grant NsG-595)
(NASA-CR-91703) CFSTI: HC $3.00/MF $0.65 CSCL 06P

Mechanisms for regulating sodium excretion in dogs were explored, and the role of atrial size and function upon the excretion of a sodium load in both men and dogs were investigated. The circulatory response of patients with cardiovascular disease to upright tilt was studied. L.S.

N68-14739# California Univ., La Jolla. Dept. of Aerospace and Mechanical Engineering Sciences.
ON THE FORMULATION OF CONSTITUTIVE EQUATIONS FOR LIVING SOFT TISSUES
William Prager Nov. 1967 12 p refs
(Grant AF-AFOSR-1186-67)
(AFOSR-67-2599; AD-662594)

Soft living tissues deform freely under negligible stresses until a certain strain level is reached at which their stiffness increases sharply. Constitutive equations are developed that describe this kind of mechanical behavior and include Hookes law as a limiting case. It is shown that, similar to Hookes law, these constitutive equations assure uniqueness of solution for a broad class of boundary value problems. Possible extensions of the theory are briefly indicated. Author (TAB)

N68-14770# Utah Univ., Salt Lake City. College of Medicine.
PERIODICITY IN THE AUTONOMIC DISCHARGE Final Report
Edward R. Perl 1 Nov. 1967 5 p refs
(Grant AF-AFOSR-748-65)
(AFOSR-67-2742; AD-662596)

Rhythmic activity of short duration is well known in the autonomic nervous system. There is evidence of rhythmic activity on a much longer phasic basis, something like one hour. This research investigates the longer phasic activity and attempts to determine its causes. Author (TAB)

N68-14807*# George Washington Univ., Washington, D. C.
BIBLIOGRAPHY ON PLANETARY QUARANTINE. VOLUME 2: ENVIRONMENTAL MICROBIOLOGY
Donald E. Wright Nov. 1967 74 p refs
(Contract NSR-09-010-027)
(NASA-CR-91805) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Citations concerned with microbial growth, detection, identification, and monitoring throughout spacecraft fabrication are presented. A permuted index of key works appearing in the title of each of the articles is included. C.T.C.

N68-14889*# Northrop Corp., Hawthorne, Calif. Systems Labs.
ORBITING EXPERIMENT FOR STUDY OF EXTENDED WEIGHTLESSNESS. VOLUME 2: SYSTEM DEFINITION
Dec. 1967 151 p refs
(Contract NAS1-6971)
(NASA-CR-66508; NSL-67-300, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Summary results are presented on a definition study of a spacecraft system, planned as a lunar excursion module substitute on an Apollo Applications Program (AAP) flight, and intended to support two primates in unattended, weightless, earth orbit for periods of 6 months to one year. The primates are to be recovered by astronaut extravehicular activity and returned to earth in retrieval canisters within the command module. Experiment requirements are delineated as to mission profiles, primate environment and life support, metabolic exchange, and environmental control. The Saturn/AAP interfaces are examined in relation to operational constraints, launch vehicle configurations, and the acceleration, acoustical vibration, and thermal environments. The overall mission profile indicates the major events and time intervals, communications requirements, and astronaut participation. The functional requirements of the subsystems are defined, and alternate missions and configurations are considered. Preliminary reliability assessments and subsystems evaluation are also included. M.G.J.

N68-14956*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PRE-GEMINI MEDICAL PREDICTIONS VERSUS GEMINI FLIGHT RESULTS
Charles A. Berry and Allen D. Catterson *In its* Gemini Sum. Conf. 1967 p 197–218 (See N68-14941 05-30)

Medical predictions concerning the effects of (1) the space environment on man and (2) human responses to prolonged space flight are evaluated, and results are compared to flight results from Mercury and Gemini missions. Medical objectives focused on determining: (1) How long man can be exposed to the space flight environment without producing significant physiologic or performance decrement; (2) the causes of observed changes; and (3) preventive measures or treatment if needed. It is concluded that although man was far more capable in the space environment than predicted, and stresses had less effect than predicted, knowledge gained during the Gemini Program should be focused on possible problems of very long duration for future flights. It is suggested that consideration be given to the following: (1) obtaining additional information on normal baseline reactions to stress in order to predict crew response; (2) determining psychological implications of long duration confinement and crew interrelations; (2) solving the difficult logistics of food and water supply and of waste management; and (3) providing easy, noninterfering physiologic monitoring. S.C.W.

N68-15003* Baylor Univ., Houston, Tex. Dept. of Psychiatry.
PERIOD ANALYSIS OF THE ELECTROENCEPHALOGRAM FROM THE ORBITAL FLIGHT OF GEMINI 7 Final Report
Neil R. Burch, Ronald G. Dossett (Tex. Res. Inst.), Abbie L. Vorderman, and Boyd K. Lester (Okla. Univ., Norman) 22 Nov. 1967 58 p refs
(Contract NSR-44-003-021; Grant PHS-FR-00254)
(NASA-CR-91661) CFSTI: $3.00 CSCL 06E

Analysis of over fifty continuous hours of electroencephalogram recordings on Gemini 7 pilots under conditions of orbital flight confirmed disturbed sleep patterns. A data reduction process by computer with a smoothing step generating a single statistic related to arousal yielded thirty-three parameters which characterized each ten second sample of the EEG record. Period count, weighted total count, and discriminant function classification of the EEG indicated that these parameters are sensitive indicators of the state of consciousness during space flight and demonstrated the qualitative and quantitative changes in the sleep patterns during flight. G.G.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-13949*# Naval School of Aviation Medicine, Pensacola, Fla.
TWO DEVICES FOR ANALYSIS OF NYSTAGMUS

Fred E. Guedry, Jr. and Gene T. Turnipseed 31 Oct. 1967 22 p refs
(NASA Order R-93)
(NASA-CR-91674; NAMI-1021) CFSTI: HC $3.00/MF $0.65 CSCL 06B

An electromechanical slope computer requires manual alignment of a crosshair with the nystagmus slope. This process is much faster than unaided manual scoring because (1) the mechanical aid in slope measurement is very effective, (2) time measurement is virtually automatic, and (3) all steps after the crosshair alignment, including tabulation of digital information and plotting of analog information, are accomplished automatically. Another device comprises a standard recorder with plug-in units for area summation and timed switching. It is less versatile than the first device and is not equivalent to advanced electronic computation, but it does provide an immediate analog display and (with a digital voltmeter-printer) an immediate digital display of analyzed nystagmus. Topics discussed include sources of error in rapid processing of nystagmus and advantages of rapid processing for experimental purposes, for aviator evaluation, and for clinical application. Author

N68-13989* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MAN'S ROLE IN EARTH-ORBITING APOLLO
T. C. Helvey 23 Nov. 1966 33 p refs
(NASA-TM-X-53541) CFSTI: $3.00 CSCL 05H

The concept of man as a component in a space system is discussed from the viewpoint of acquainting engineers with the complexities involved in integrating man with the Apollo and especially of designing useful activity in the empty fuel container, the S-4-B stage. The idea of using the container as an environmental test chamber is proposed for retesting components and subsystems under true space environment conditions; the results might provide data for increasing mean time between failure during long duration space flights. Man–machine and man–man–machine relationships are discussed in relation to the new dimensions which will be required in the thinking of the design engineer, and the performance enhancements which will be achieved. Cybernetic concepts are examined in terms of the man–machine feedback process, the modification of man's rate and gain capability, and human transfer functions between visual perception and command. Problems dealing with the psychophysiological machinery of the human body are considered. M.G.J.

N68-13999* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CARDIAC R-WAVE DETECTOR
Vernon D. Gebben Washington Jan. 1968 13 p refs
(NASA-TM-X-1489) CFSTI: $3.00 CSCL 06B

A method of detecting the R-wave of the electrocardiac signal was developed for controlling the timing cycle of heart-assist pumps. Dependable separation of the R-wave from high-level electrical interferences was obtained from a circuit that contains high common-mode rejection, a band-pass filter, an amplitude detector, and a pulse-width discriminator. An experimental circuit was tested using copper surface electrodes located on the right arm and left leg. All false signals except those generated by vigorous motion or extreme muscle tensions were rejected by the circuit. Author

N68-14166* California Univ., Santa Barbara.
INTERRELATIONS OF PERCEIVED SIZE AND DISTANCE Semiannual Progress Report, Jun.–Dec. 1967
Walter C. Gogel Dec. 1967 8 p refs
(Grant NGR-05-010-010)
(NASA-CR-91702) CFSTI: $3.00 CSCL 05J

An experiment is described which investigates the existence of a tendency to perceive objects at some particular specific distance. It is felt that there may be such a tendency, and the significance of such a tendency is discussed. Theory on the perception of size in a distorted room is briefly described. N.E.N.

N68-14195*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF PASSIVE TEMPERATURE AND HUMIDITY CONTROL SYSTEMS FOR ADVANCED SPACE SUITS Interim Report, 1 Jul. 1966–1 Sep. 1967
Arnold P. Shlosinger Sep. 1967 77 p refs
(Contract NAS2-3817)
(NASA-CR-73168; TRW-06462-6002-R000) CFSTI: HC $3.00/MF $0.65 CSCL 06K

Investigations were performed to develop techniques for control of temperature in an extravehicular space suit by passive means. These techniques are intended to be integrated with techniques for passive control of humidity in space suits. The techniques investigated are based on the use of the external suit surface as thermal radiator for rejection of excess metabolic heat and on a space suit shell of controllable overall thermal conductance. The controllable thermal conductance is achieved by a system of thermal insulation which is bypassed by devices similar to "Heat Pipes", modified to provide controllable heat flow rates and geometries applicable to a space suit. Theoretical and experimental investigations demonstrated feasibility of the concept of a variable thermal conductance heat pipe. Concepts for the integration of a variable thermal conductance heat pipe into the fiberglass shell of a hard space suit were developed and fabrication techniques generated. Author

N68-14243*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Biotechnology and Power Dept.
ANALYTICAL SIMULATION OF THE LANGLEY RESEARCH CENTER INTEGRATED LIFE-SUPPORT SYSTEM, VOLUME 1
B. N. Taylor and R. S. Barker Jan. 1968 48 p refs
(Contract NAS1-6448)
(NASA-CR-66454; DAC-59177, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 06K

Two analytical models were prepared for the simulation of the integrated life support system (ILSS) and the oxygen recovery system. Sample problems for the ILSS model include performance analyses of the design and off-design, an improved modified subsystem component, the failure mode, and a potential servo system for control of compartment temperature. A sample problem for the O_2-regeneration system model was formulated to determine component characteristics required to achieve performance goals. Compared analytical and experimental data show good agreement in values obtained for cabin temperature, absolute humidity, and CO_2 partial pressure. Recommended are long-range improvements, corresponding to advances in the state of the art of simulation methods, and short range improvements consisting of minor changes of input data. B.S.D.

N68-14262*# Serendipity Associates, Chatsworth, Calif.
A DESCRIPTIVE MODEL FOR DETERMINING OPTIMAL HUMAN PERFORMANCE IN SYSTEMS, VOLUME 1
Washington NASA Jan. 1968 186 p refs
(Contract NAS2-2955)
(NASA-CR-876) CFSTI: HC $3.00/MF $0.65 CSCL 05H

CONTENTS:

1. A SIMPLE MODEL OF A MAN-MACHINE DEVELOPMENT CYCLE. PART A J. J. Wulff and J. N. Leonard 128 p refs (See N68-14263 05-05)

2. A SIMPLE CALCULUS FOR DISCRETE SYSTEMS. PART B J. J. Wulff, A. F. Pixley (Harvey Mudd Coll.), and J. N. Leonard 31 p refs (See N68-14264 05-19)

N68-14263*# Serendipity Associates, Chatsworth, Calif.
A SIMPLE MODEL OF A MAN-MACHINE DEVELOPMENT CYCLE, PART A
J. Jepson Wulff and John N. Leonard *In its* A Descriptive Model for Determining Optimal Human Performance in Systems, Vol. 1 Jan. 1968 129 p refs (See N68-14262 05-05)

A model is presented for system managers who predict and control the course of a complex aerospace system development cycle so that the system will include man in an optimal manner. Emphasis was placed on serving the needs of system managers concerned with personnel products rather than the needs of hardware engineers. Technical terms used in evolving the model are discussed. An eight-function index model was prepared to provide both detail in a small area and also an overview of the whole. Details are given on the full development cycle model, and uses of the model are described. It is pointed out that the management set includes technical and general management at all levels, and that the modeling technique is readily translated into a PERT model. N.E.N.

N68-14326# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PACIFIC NORTHWEST LABORATORY. VOLUME 2: PHYSICAL SCIENCES. PART 4: INSTRUMENTATION Annual Report, 1966
D. W. Pearce, ed. and M. R. Compton, ed. Aug. 1967 51 p *ref*
(Contract AT(45-1)-1830)
(BNWL-481, V. 2, Pt. 4) CFSTI: HC $3.00/MF $0.65

Instrumentation development for work in the physical sciences is reviewed. Fourteen studies are described under the following headings: aquatic environment dose rate monitor; miniature dose rate measurement instrument; life-time and half-life control of scanner for whole body radiation counter; measurement of mixed field neutron and gamma dose rates; wound counting with solid state detectors; counting of plutonium in the lung; animal activity monitor apparatus; tidal volume air measurement; accelerator ion beam current regulator; electronics development for solid state diode detectors; surface contoured diodes; X-ray/alpha studies with solid state detectors; neutron sensitive criticality alarm system; and raindrop charge measuring systems. E.C.

N68-14329* Naval School of Aviation Medicine, Pensacola, Fla.
A COUNTERROTATOR FOR HUMAN CENTRIFUGE APPLICATION
W. Carroll Hixson and John J. Anderson 27 Oct. 1967 13 p refs
(NASA Order R-93)
(NASA-CR-91677; NAMI-1020) CFSTI: $3.00 CSCL 06B

A man-rated vestibular research device, the Counterrotator (CORO), has been developed to investigate man's response to the dynamic linear acceleration environment afforded by counterrotation aboard a centrifuge. The device proper is a small earth-vertical rotator which utilizes a dc torque motor operated as a closed-loop position servo to turn a seated subject about his *z* head axis. When installed aboard the radial arm of the Coriolis Acceleration Platform (CAP), a centrifuge-like rotator, the CORO drive system will track the angular motions of CAP over the 0- to 100-deg/sec velocity range at angular accelerations extending to 15 deg/sec^2. The device is rated to achieve this 1:1 counterrotation capability in low-level, variable magnitude, centripetal acceleration fields extending from 0 to 1.75 *g* nominal. Author

N68-14335* National Aeronautics and Space Administration, Washington, D. C.
CONTRIBUTION OF A DEVELOPMENTAL INTEGRATED LIFE SUPPORT SYSTEM TO AEROSPACE TECHNOLOGY
J. N. Pecoraro, A. O. Pearson (NASA, Langley Res. Center), G. L. Drake (Gen. Dyn./Convair), and J. R. Burnett (Gen. Dyn./Convair) 1967 17 p refs Presented at the AIAA 4th Ann. Meeting and Tech. Display, Anaheim, Calif., 23–27 Oct. 1967
(NASA-TM-X-60799) CFSTI: $3.00 CSCL 06K

The Integrated Life Support System (ILSS) at NASA Langley (LRC) is discussed. The ILSS program to date has demonstrated: (1) the feasibility of the regenerative integrated life support system concept; (2) that designs which provide ease of maintenance, high reliability, and minimal logistics are not now within the state-of-the-art; (3) that fluid leakage problems, both liquid and gaseous, will continue to be a significant challenge for development; (4) many of the limitations existing within the technology to meet the crew comfort requirements of long duration missions especially as related to air circulation, noise, and vibration. Author

N68-14365# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
PROVISIONAL AEROSPACE WATER STANDARDS—1964 Final Report, 1962–1963
A. R. Slonim and A. J. Roth, Jr. Dec. 1966 25 p refs
(AMRL-TR-66-252; AD-662611)

Provisional potable water standards, patterned after the 1962 USPHS Drinking Water Standards, were formulated for application to aerospace systems. In comparison with USPHS standards, the recommended maximal allowances have been raised (relaxed) at least 80%, with the majority increased from two- to five-fold, for the following 16 out of 20 chemical constituents: alkyl bensene sulfonate, arsenic, barium, cadmium, chloride, copper, cyanide, iron, lead, manganese, nitrate, phenols, selenium, silver, total dissolved solids, and zinc. Four constituents, carbon chloroform extract, chromium, fluoride and sulfate, remain relatively unchanged. The radiological requirements are the same as USPHS for radium226, strontium90 and gross beta emitters. The only change in the physical properties concerning turbidity, color, odor and taste in these standards as compared with USPHS is a fivefold increase in the turbidity level. For the microbiological quality of water, it has been recommended (at this time) that the potable water be free of all microorganisms to minimize potential health hazards to aerospace personnel. The importance of selection of materials for aerospace systems, improvement in analytical methods (e.g., detection of organic contaminants), and resolution of problems needing attention to the development of permanent potable water standards is discussed. Author (TAB)

N68-14426# United Kingdom Atomic Energy Authority, Harwell (England).
DOSIMETRIC AND RADIOBIOLOGICAL EXPERIMENTS WITH FAST NEUTRONS, PART 1
K. G. Zimmer [1967] 18 p refs Transl. into ENGLISH from Strahlentherapie (Munich), v. 63, 1938 p 517–527
(NP-TR-1575) CFSTI: HC $3.00/MF $0.65

The adaptation of a small tissue-equivalent ionization chamber for use in fast neutron dosimetry is described. Fundamental principles and fundamental testing of the method are discussed. NSA

N68-14505# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
GENERAL DESCRIPTION AND EVALUATION OF AN ON-LINE OXYGEN UPTAKE COMPUTER
Abbott T. Kissen, Donald W. McGuire (Dayton Univ.), and John J. Sterling (Technol., Inc., Dayton, Ohio) Jun. 1967 44 p refs Prepared jointly with Dayton Univ. and Technol., Inc.
(Contracts AF 33(615)-2182; AF 33(615)-3230)
(AMRL-TR-67-17; AD-662624)

A series of experiments has been designed to evaluate the performance of an oxygen uptake computer. The Model OCC-2500 oxygen uptake computer is an electronic instrument

including a mask-sensor assembly and a special-purpose analog computer. Intended for the analysis of respiratory gases in human subjects, the system produces a real-time analog voltage proportional to the oxygen uptake in one minute or other time periods controlled by the operator. Expired air samples, monitored by the polarographic oxygen sensor and mass gas flowmeter of the computer system were simultaneously collected in a gasometer and analyzed by gas chromatography. Oxygen uptake values (200-3200 cc/min) obtained from 15 subjects (297 observations) during rest and after exercise produced a sample correlation coefficient of 0.998. Subjects enjoy virtually unrestrained mobility using the device. in that attachment to monitoring equipment is limited to electrical leads. Personnel support requirements and errors, associated with conventional procedures, are significantly reduced. The compact nature of the device permits application in almost any experimental design situation including presurized suits and underwater studies.
Author (TAB)

N68-14511# Tech Development, Inc., Dayton, Ohio.
THE DEVELOPMENT OF A TURBINE-DRIVEN CIRCULATING BLOWER FOR MANNED AEROSPACE ENCLOSURES Final Report, Jun. 1965–Feb. 1967
Joseph Flatt Wright-Patterson AFB, Ohio AMRL Aug. 1967 28 p refs
(Contract AF 33(615)-2965)
(AMRL-TR-67-126; AD-662623)

Analytical and experimental studies were conducted to determine an optimum turbine-driven circulating blower powered by energy available from high- pressure breathing oxygen. The studies included experimental determination of optimum turbine and nozzle geometries and the development of a complete circulating blower, with an available oxygen flow of 0.2 pound per hour, the blower can circulate 3.93 CFM at a back pressure of 0.2 inch of water in an ambient temperature, 5-psia atmosphere. Total weight of the unit was 3 ounces. The experimental unit operated reliably; however, additional testing is necessary to establish its suitability for use in a manned space enclosure.
Author (TAB)

N68-14512# School of Aerospace Medicine, Brooks AFB, Tex.
DESIGN AND DEVELOPMENT OF A DIGITAL CARDIOTACHOMETER
Adolph W. Foeh, Jr. Apr. 1967 8 p refs Presented at the 19th Ann. Southwestern IEEE Conf. and Exhibition, Dallas Submitted for publication
(SAM-TR-66-334; AD-662329)

The paper describes the design of a digital cardiotachometer with an accuracy of greater than one beat per minute and a range of 40 to 200 beats per minute. At each beat of the heart, the time interval between that beat and the previous beat is converted to rate and presented on output lines in parallel binary form suitable for recording on digital magnetic tape.
Author (TAB)

N68-14752 Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.
A PORTABLE DEVICE FOR THE MEASUREMENT OF EVAPORATIVE WATER LOSS
G. E. Funkhouser and S. M. Billings Aug. 1967 10 p refs
(AM-67-17)

A portable device was developed for the precise measurement of evaporative water loss. Under appropriate conditions the measurement of evaporative water loss may be used as an index of emotional stress in flying personnel. The apparatus incorporates a thermal conductivity cell as a moisture sensor, a proportional heater control to maintain the cell at the proper temperature, and a compressed air circuit to act as a carrier for water vapor. The unit is entirely battery powered.
Author

N68-14788# Southwest Research Inst., San Antonio, Tex.
HIGH SENSITIVITY NUCLEAR MAGNETIC RESONANCE FOR THE QUANTITATIVE ANALYSIS OF BODY FLUIDS Final Report, 1 Aug. 1966–1 Feb. 1967
G. A. Persyn, J. M. Victor, and W. L. Rollwitz Brooks AFB, Tex. School of Aerospace Med. Aug. 1967 27 p refs
(Contract F41609-67-C-006)
(SAM-TR-67-70; AD-662323)

Magnetic resonance measurements on the electronic (free radicals) and nuclear (protons) moments in diphenylpicrylhydrazil were made using a superconducting tuned circuit as the sensing element. Two operating frequencies, 30 MHz and 0.95 MHz, were used in these experiments. Signal-to-noise improvements between 5,000 and 16,000 were obtained over the non-superconducting mode. The quality factor of the superconducting resonant circuits ranged from a low of 10,000 to a high of 2,800,000. A major limitation to high quality factor was the low temperature loss properties of the dielectrics used in the construction of the tuned circuit. Three types of detection schemes were used: (1) Rollins type, (2) Rollins type with MOS Fet amplifier held at 4.2K, and (3) Robinson-type marginal oscillator. Design criteria are presented to circumvent line broadening due to magnetic flux expulsion of the Meissner effect from the superconducting radiofrequency coil.
Author (TAB)

N68-14795# Melpar, Inc., Falls Church, Va.
CRYOGENICALLY TRAPPED TRACE CONTAMINANTS ANALYZED BY IONIZING GAS CHROMATOGRAPHY
Hannibal De Schmertzing, Sol S. Nelson, and Harold G. Eaton Brooks AFB, Tex. School of Aerospace Med. Aug. 1967 15 p ref
(Contract AF 41(609)-2958)
(SAM-TR-67-68; AD-662330)

The purpose of this work was to determine quantitatively the concentration of microcontaminants in a sealed environmental system. The separation and identification of the cryogenically trapped trace contaminants were accomplished with liquid gas chromatography using a flame ionization detector. Thirty-nine sets of samples were analyzed, each set consisting of 3 cylinders. Nine sets of samples were taken during a manned simulator run conducted at Brooks Air Force Base in October to November 1965, 29 sets from a similar run conducted in March to April 1966, and one sample set from a trapping efficiency run. The compounds contained in the sample cylinders were identified by their time of elution from a column and the amount measured with the aid of peak areas. The response characteristics of the chromatography were calculated from responses obtained with standard mixtures.
Author (TAB)

N68-14799# Bureau of Mines, Pittsburgh, Pa.
PERFORMANCE OF OPEN CIRCUIT SELF CONTAINED BREATHING APPARATUS AT −25°F
E. J. Kloos, L. D. Raymond, and L. Spinetti Feb. 1968 21 p refs
(BM-RI-7077)

Self-contained breathing apparatus of the compressed air demand type were evaluated at low temperature. Apparatus durations, breathing resistances, and airflow rates were measured on machine tests at room temperature and −25°F. Man tests under actual wearing conditions verified the machine test results. Many serious functional changes in apparatus performance occurred at low temperature. Pressure regulators malfunctioned when diaphragms lost flexibility. Under certain conditions frozen condensed moisture sealed exhalation valves and fogged eyepieces. High-pressure leaks, not encountered at ordinary temperature, developed at low temperature. Tests results are discussed for each apparatus, recommendations are given to obtain optimum performance.
Author

N68-14947*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

LIFE SUPPORT SYSTEMS FOR EXTRAVEHICULAR ACTIVITY

Harold J. McMann, Elton M. Tucker, Marshall W. Horton, and Frederick T. Burns *In its* Gemini Sum. Conf. 1967 p 67–77 (See N68-14941 05-30)

Life support systems designed for manned extravehicular activities which were developed during the Gemini Program are described. The system described consisted of a space suit, a portable environmental control system, and an umbilical link with the spacecraft. Analyzed is the development of this system and related components from the original concepts through the modifications imposed by specific missions. S.C.W.

N68-14948*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

BODY POSITIONING AND RESTRAINTS DURING EXTRAVEHICULAR ACTIVITY

David C. Schultz, Hilary A. Ray, Jr., Eugene A. Cernan, and Antoine F. Smith *In its* Gemini Sum. Conf. 1967 p 79–90 (See N68-14941 05-30)

Described are body positioning and restraint problems encountered during extravehicular activity in the Gemini Program, and the types of restraint equipment which were used. The requirements for body restraints which were indicated during extravehicular activity on Gemini IV, IX-A, XI, and XII missions are discussed. The restraints that were found to be most satisfactory during the Gemini Program included: (1) Gemini XI foot restraints which were used for rest and localized work; (2) Gemini XII waist tethers which were used for rest and localized work; (3) rectangular handrail used for translating across a spacecraft surface; (4) pin–pin devices for combination tether-attach points and handholds. One of the foremost conclusions obtained from experiences during these missions was that man's capability to perform work was drastically reduced without the proper restraint provisions; however, with the proper restraint provisions his capability was quite comparable to his 1g capability. These missions also indicated that during extravehicular activity, restraints must be provided for rest as well as for work. S.C.W.

N68-14949*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

EXTRAVEHICULAR MANEUVERING ABOUT SPACE VEHICLES

Harold I. Johnson, William C. Huber, Edward H. White, II, and Michael Collins *In its* Gemini Sum. Conf. 1967 (See N68-14941 05-30) p 91–105

Maneuvering equipment used for extravehicular activity during the Gemini Program is described. Considered is the hand held maneuvering unit which was scheduled for the Gemini IV, VII, X, and XI missions; and the astronaut maneuvering unit which was designed for the Gemini IX-A and XII missions. Also described are ground training equipment and the methods used in preparing the flight crews for extravehicular maneuvering. Flight results obtained with the hand held maneuvering unit during Gemini IV and Gemini X are summarized, and comparisons are made between flight performance and ground training indications. S.C.W.

N68-14950*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

MEDICAL ASPECTS OF GEMINI EXTRAVEHICULAR ACTIVITIES

G. Fred Kelly and D. Owen Coons *In its* Gemini Sum. Conf. 1967 p 107–125 (See N68-14941 05-30)

Medical aspects of Gemini extravehicular activities which are primarily concerned with the physiological responses to high workloads, high thermal stresses, and low fatigue tolerance, are discussed. Analyses of these factors indicated that: (1) Major factors which appear to have produced the highest workload during the extravehicular activity were high suit forces, insufficient body position aids, and thermal stress. (2) Much can be learned about the physiological responses to extravehicular activities from simulations in the zero-g aircraft and in an underwater mockup; however, without specific knowledge of the thermal and environmental condition, a realistic simulation of extravehicular activities will be incomplete and possibly misleading. (3) The successful completion of the Gemini extravehicular activities indicates that life support planning has been essentially sound. (4) Within the limitations of experience gained (Gemini XII), time lines and work tasks can be tailored so that flight objectives can be accomplished. S.C.W.

N68-14951*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

SUMMARY OF GEMINI EXTRAVEHICULAR ACTIVITY

Reginald M. Machell, Larry E. Bell, Norman P. Shyken (McDonnell Aircraft Corp.), and James W. Prim, III *In its* Gemini Sum. Conf. 1967 p 127–146 (See N68-14941 05-30)

Summarized are extravehicular activities achieved during Gemini IV, VIII, IX-A, X, XI, and XII missions. Included in a discussion of (1) extravehicular capabilities which were demonstrated during the Gemini missions, as for example, the ability to control the extravehicular workload and to maintain the workload within the limits of the life support system and pilot capabilities; and (2) a discussion of significant limitations encountered, such as space suit mobility restrictions; and their solutions. Results of the Gemini extravehicular activity led to several significant conclusions among which are cited: (1) Extravehicular operation in free space is feasible and useful for productive tasks if adequate attention is given to body restraints, task sequence, workload control, realistic simulations, and proper training. (2) Underwater simulation provides a high fidelity duplication of the extraterrestrial environment and should be used for procedures development and crew training for future missions. (3) The hand held maneuvering unit is promising as a personal transportation device in free space; however, further evaluations in orbital flight are warranted to define its full capabilities and limitations. (4) The Gemini Program has provided a foundation of technical and operational knowledge on which to base future extravehicular activity in subsequent programs. S.C.W.

N68-14989*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

SECONDARY-SIGNAL CONTROL IMPULSES, ELECTRICAL REACTIONS AND SENSITIVITY OF ANALYZERS [GLAVA VI: VTOROSIGNAL'NYYE UPRAVLYAYUSHCHIYE IMPUL'SY, ELEKTRICHESKIYE REAKTSII I CHUVSTVITEL'NOST' ANALIZATOROV]

N. I. Chugrikova Washington NASA Jan. 1968 36 p Transl. into ENGLISH from the book "Slovo Kak Faktor Upravleniya v Vysshey Nervnoy Deyatel'nosti Cheloveka" Moscow, Prosveshcheniye, 1961 p 217–252

(Contract NASw-1692)

(NASA-TT-F-11432) CFSTI: HC$3.00/MF$0.85 CSCL 06B

Many investigators have shown conclusively that the amplitude and latent period of evoked potentials (in direct stimulation in man) are dependent on secondary-signal effects produced by verbal instructions used in the experiment. In addition to the evoked potentials, other aspects of the electrical activity of the human brain may undergo significant changes under the influence of verbal stimuli (depression of alpha rhythm, etc.) Many recent works indicates that the sensitivity of analyzer systems is a much more complex function than was heretofore believed. There may be a difference in the excitability of various links in the ascending afferent pathway, and regulatory mechanisms may alter the functional states of all the structures in the analyzer. Author

N68-14888# California Univ., Livermore. Lawrence Radiation Lab.
A POWERED AIR-PURIFYING RESPIRATOR
William A. Burgess (Harvard School of Public Health) and William Nettleton 23 May 1967 13 p refs Prepared jointly with Harvard School of Public Health, Boston
(Contract W-7405-ENG-48)
(UCRL-50283) CFSTI: HC$3.00/MF$0.65

The advantages of a personal powered air-purification respirator were previously described. The device considered satisfies the design aim to provide a unit with a protection factor of 1000 against particulates when used with half-masks, full-face masks, rigid helmets, and hoods. The size, shape, and weight of the device are consistent with normal restraints of emergency and routine use. The design reflects the need for an inexpensive, all-purpose device for wide industrial application. Although the initial application of this device was with ultrahigh efficiency filters, its performance was also evaluated with medium-efficiency felt filters, activated charcoal canisters, and combination canisters. The design of the unit permits operation with a variety of battery packs. The standard pack is a rechargeable battery system that provides a life of approximately 3 hr with a nominal delivery of 5 cfm. Alkaline batteries provide an economical "one-shot" power supply with a battery life of approximately 14 hr with reduced delivery. Author (NSA)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-13968# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
SAMPLING FFTF SODIUM COOLANT FOR ANALYTICAL PURPOSES
F. A. Scott Sep. 1967 33 p refs
(Contract AT(45-1)-1830)
(BNWL-491) CFSTI: HC$3.00/MF$0.65

The current state of the art of liquid-metal-coolant sampling was reviewed with particular emphasis on the sampling of highly radioactive streams in operating reactors and on the requirements of the FFTF (Fast Flux Test Facility) program. The advantages, disadvantages, available experience, and applicability to FFTF needs of each of the four most promising means of removing a small representative portion of the loop coolant (initial sampling) were compared. Similar comparisons were made for the techniques commonly used to obtain the actual analytical sample from this initial sample (secondary sampling). Based on these comparisons, a conceptual design for the FFTF sodium sampling system is described. The experimental program required to develop and test prototypical samplers is outlined. Author (NSA)

N68-13881# Oak Ridge National Lab., Tenn.
X-RAY DIFFRACTION DATA ON LIQUID 2,2-DIMETHYLPROPANE (NEOPENTANE) AT 25°C
A. H. Narten and H. A. Levy Apr. 1967 29 p refs
(Contract W-7405-ENG-26)
(ORNL-4103)

The scattering of X-rays from the free surface of liquid neopentane in equilibrium with its vapor has been measured at 25°C. The diffractometer used was specially designed for the study of liquid structure. In this report, both the raw data and the intensity and radial distribution functions derived from them are presented in tabulated form. Intramolecular distances obtained in this study are in agreement with those derived from gas diffraction experiments. Author

N68-13908# Bureau of Mines, Rolla, Mo. Metallurgy Research Center.
MAGNETIC SUSCEPTIBILITY OF 34 MANGANESE-BEARING MINERALS
Howard E. Powell and Lee R. Ballard Jun. 1968 12 p refs
(BM-IC-8359)

The magnetic susceptibilities of 34 manganese-bearing minerals were determined. The source of each sample and petrographic, spectrographic, and chemical analyses are given. Included are values for isomorphous series showing wide ranges of composition and for a few high-purity synthetic minerals. Author

N68-14008# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
HIGH TEMPERATURE STABILITY OF THULIUM OXIDE
P. Kent Smith Sep. 1967 17 p refs
(Contract AT(07-2)-1)
(DP-1116) CFSTI: HC$3.00/MF$0.65

The material properties of Tm_2O_3 make ^{170}Tm attractive for use in high-temperature isotopic power sources. To establish specifications for reactor target materials suitable for irradiation in forms that might be considered for direct use in isotopic power sources, the high-temperature stability of Tm_2O_3 was calculated from thermodynamic data; the temperature dependence of vapor pressure, the boiling point, and the heat of vaporization were derived. Data indicate that the oxide is exceptionally refractory. Author (NSA)

N68-14011# National Bureau of Standards, Washington, D. C.
ANALYTICAL MASS SPECTROMETRY SECTION Summary of Activities, Jul. 1966-Jun. 1967
William R. Shields, ed. 15 Sep. 1967 63 p refs
(NBS-TN-426) GPO: $0.40

Advances in instrumentation include the construction of a multi-stage mass spectrometer, a high vacuum beam valve, a Z focusing lens, a re-designed collector, a filament degas chamber, and new equipment for sample drying. The new facilities at Gaithersburg are described. Elements studied during this period include: B, Cr, Pb, Rb, U, and Pu. Chemical procedures are given for B, Cr, Pb, and Pu; mass spectrometric procedures are given for B, Cr, Pb, Pu, Rb, and U. Author

N68-14029# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
THE REMOVAL OF SILICA FROM PLUTONIUM PROCESSING ANION EXCHANGE RESIN BY CAUSTIC WASH
Robert P. De Grazio 11 Oct. 1967 3 p refs
(Contract AT(29-1)-1106)
(RFP-1037) CFSTI: HC$3.00/MF$0.65

DOWEX-1 anion exchange resin is used for the recovery and purification of plutonium from nitrate solutions. Silica (SiO_2) is present in certain plutonium recovery streams and is absorbed rapidly on anion resin columns. Consequently, the resin columns are plugged, preventing efficient processing of the plutonium. Experiments were conducted on a laboratory scale to determine the feasibility and effectiveness of removing silica from anion exchange resins with a sodium hydroxide wash. The results indicate that the procedure developed will effectively remove the silica and considerably increase the operational lifetime of the resin. Data show that approximately 98% of the absorbed silica is removed. The concentration of plutonium in the caustic waste solution was below discard level, and therefore, did not require additional processing. Author

N68-14047# Autonetics, Anaheim, Calif. Advanced Technology Branch.

STUDY OF A POSITION-CLASSIFICATION COMPUTER Final Report, Mar.–Aug. 1967

James A. Luisi 25 Aug. 1967 70 p refs Prepared for Calif. Univ., Lawrence Radiation Lab., Livermore

(Contract W-7405-ENG-48)

(C7-1940/501; UCRL-13312) CFSTI: HC $3.00/MF $0.65

The selection of memory hardware for a position-classification computer is discussed. The computer operates on measurements from inertial instruments to perform navigation-computations. The computer must then classify the resulting position-coordinates with respect to a stored map. A combination of Read/Write and Read Only memory was recommended to reduce size, power-dissipation and cost. Author (NSA)

N68-14058# National Bureau of Standards, Washington, D. C.

MICROCHEMICAL ANALYSIS SECTION: SUMMARY OF ACTIVITIES, JULY 1966–JUNE 1967

John K. Taylor, ed. Oct. 1967 90 p refs

(NBS-TN-425) GPO: $0.50

Research activities and scientific programs are reported for the period July 1966 to June 1967. General activities are reported in the areas of gas analysis, polarography, potentiometry, coulometry, chemical microscopy, and classical microchemical analysis. Research accomplishments described in some detail include the following: high pressure mass spectrometry; high precision differential polarography; an improved coulometric technique for titration of halides; developments in micro null-point potentiometry; techniques for the accurate weighing of small liquid samples. A number of microchemical procedures which have been developed for the analysis of a variety of materials are also included. Author (NSA)

N68-14068# Atomic Energy Commission Research Establishment, Riso (Denmark). Isotope Lab.

NEW METHODS FOR THE CARRIERFREE PRODUCTION OF VARIOUS ISOTOPES BY THE LIQUID LIQUID EXTRACTION TECHNIQUE

M. Younas Mirza Aug. 1967 41 p refs

(RISO-159)

The extraction of Fe^{+3}, Cr^{+3}, Ni^{+2}, Co^{+2}, Mn^{+2}, Zn^{+2}, Sc^{+3}, Y^{+3}, La^{+3}, alkali metals, alkaline earth metals, rare earth elements, and fission products at various pH values into methyl isobutylketone containing 4-capryl-1-phenyl-3-methylpyrazolone-5 (PMCyP) was investigated. The quantitative extraction of Fe^{+3}, Y^{+3}, In^{+3}, Sc^{+3}, Sb^{+3}, rare earths, Ca^{+2}, Sr^{+2}, Cd^{+2}, Zn^{+2}, Co^{+2}, and Mn^{+2} was utilized for devising radiochemical procedures for the carrier-free separation of ^{54}Mn, ^{58}Co, ^{59}Fe, ^{45}Ca, ^{89}Co, ^{115}Cd, and $^{89,90}Sr$ produced by $^{54}Fe(n,p)^{54}Mn$, $^{58}Ni(n,p)^{58}Co$, $^{59}Co(n,p)^{59}Fe$, $^{45}Sc(n,p)^{45}Ca$, $^{89}Y(n,p)^{89}Sr$, $^{238}U(n,f)^{115}Cd$, and $^{238}U(n,f)^{89,90}$ reactions and also for the separation of ^{140}La from ^{140}Ba–^{140}La, ^{90}Y from ^{90}Sr–^{90}Y, Sr from Sr–Ba, and ^{115m}In from ^{115}Cd–^{115m}In mixture, respectively. More than 90% added or calculated activities with a good decontamination factor were recovered. Author (NSA)

N68-14069# Atomics International, Canoga Park, Calif.

THE DETERMINATION OF OXYGEN IN SODIUM BY THE AMALGAMATION METHOD

J. M. Scarborough and F. F. de Vries 25 Sep. 1967 18 p refs

(Contract AT(04-3)-701)

(NAA-SR-12250) CFSTI: HC $3.00/MF $0.65

Detailed analytical procedures for the determination of oxygen content in sodium by the amalgamation method are presented. The procedures are suitable for the analysis of sodium samples containing from one to ten micrograms of oxygen. Some of the problems encountered and solved in improving the method are described. Author (NSA)

N68-14081# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.

AN EMPIRICAL EQUATION OF STATE FOR CARBON DIOXIDE COVERING A WIDE RANGE OF TEMPERATURE AND PRESSURE

R. Sandri and J. K. S. Wong Aug. 1967 13 p refs

(NRC-9855; MP-45)

An empirical equation of state is proposed for gaseous carbon dioxide $P = -f_0(\rho) + f_1(\rho)\,T - f_2(\rho)\,T^2$ which for low densities assumes the form $P = \rho\,RT + \rho^2\,f(T)$. Tables are presented for the functions $f_0(\rho)$, $f_1(\rho)$, $f_2(\rho)$ and $f(T)$. The equation is applicable to temperatures from 50°C to 1,000°C and to pressures up to 1,400 Bar. The maximum deviation from experimental results is less than 0.9%. On the basis of this equation, internal energy, entropy, and specific heat at constant volume can be expressed by formulae containing other empirical functions of density or of temperature. Author

N68-14093*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

SYNTHESIS OF ULTRAHIGH MOLECULAR-WEIGHT POLY(ETHYLENE TERREPHTHALATE)

Li-Chan Hsu Washington Jan. 1968 13 p refs

(NASA-TN-D-4335) CFSTI: HC $3.00/MF $0.65 CSCL 11I

This study was conducted to synthesize poly(ethylene terephthalate) or PET of number-average molecular weight of the order of 120,000. PET of number-average molecular weight of the order of 120,000 was prepared with a gas chromatograph apparatus through solid-state polymerization technology. PET particles were packed in the column, heated to a temperature somewhat below the melting temperature, and flushed with a carrier gas until the desired molecular weight was reached. Parameters studied were the catalyst, the particle size, the molecular weight of the starting material, the reaction temperature and time, and the flow rate and nature of the carrier gas. The results showed that ester interchange catalysts such as tetraisopropyl titanate, zinc acetate–antimony trioxide, and cobaltous acetate are capable of increasing the molecular weight of PET. Small particle size and high molecular weight of the starting material are essential for obtaining products of ultrahigh molecular weight. The polymerization of PET in the solid state starts around 175°C (448°K); the molecular weight of the final product increased with increasing temperature for the period of time studied. Molecular weights are also increased by increasing the carrier gas flow rate to a certain practicable value, which varies with other polymerization conditions. Author

N68-14110# Michigan State Univ., East Lansing.

[ON PHYSICAL CHEMISTRY] Technical Progress Report, 13 Sep. 1966–15 Sep. 1967

James L. Dye 15 Sep. 1967 8 p refs

(Contract AT(11-1)-958)

(COO-958-12) CFSTI: HC $3.00/MF $0.65

Research progress is reported on EPR spectra of alkali metals in pure and mixed solvents. The effects of solvent purity are being determined. Investigations of the kinetics of fast reactions using stopped-flow techniques were continued in two general areas: reactions between alkali metal solutions and solutes in ethylenediamine and reactions of Aromatic anions in ethylenediamine and other solvents. Some *ab initio* molecular orbital calculations on model systems were initiated. NSA

N68-14111 Bureau of Mines, Minneapolis, Minn.

PARAMETERS AFFECTING REDUCTION–INDURATION OF UNFIRED MAGNETITE PELLETS

R. B. Schluter and M. M. Fine Jan. 1968 24 p refs

(BM-RI-7069)

Magnetite pellets were simultaneously reduced and indurated in a laboratory scale in order to determine the effects of temperature, induration time, degree of metallization, and sulfur

content upon the physical and chemical properties of prereduced pellets. The reductants were commercially-pure tank gases. Among the findings were these: 1,100°C is the minimum temperature that will produce acceptably hard pellets using carbon monoxide as the reducing gas. Prolonged treatment time improves the pellets' crushing strength, but the rate of improvement falls off sharply after 2 hours' induration. At 1,120°C, 75-percent metallization produces the maximum crushing strength; there was no corresponding peak at 900° or 1,050°C. Sulfur in the furnace atmosphere lowers the required induration temperature. A few tenths of 1 percent sulfur in the pellet increases the sintering rate of metallic iron in pellets by forming a liquid FeS phase that facilitates iron transfer. Author

N68-14113# Bureau of Mines, Reno, Nev.
EXTRACTION BEHAVIOR OF CERIUM-GROUP LANTHANIDES IN A PRIMARY AMINE-CHELATING AGENT SYSTEM
D. J. Bauer, R. E. Lindstrom, and K. B. Higbie (Bur. of Mines, Wash., D. C.) Feb. 1968 14 p refs
(BM-RI-7100)

A primary amine extraction system was investigated for fractionating a cerium-group, lanthanide sulfate mixture. Addition of diethylenetriaminepentaacetic acid (DTPA) to the amine extraction system resulted in separation factors as high as 5.4 for lanthanum–cerium, 8.0 for cerium–praseodymium, 3.7 for praseodymium–neodymium, and 7.0 for neodymium–samarium. In multistage studies on a cerium-free lanthanide mixture, 98% of the lanthanum was recovered with a purity of 95%. Author

N68-14118# Union Carbide Nuclear Co., Oak Ridge, Tenn. Computing Technology Center.
A NUMERICAL SOLUTION OF A SYSTEM OF ORDINARY AND NON-LINEAR PARTIAL DIFFERENTIAL EQUATIONS
Dale W. Lick and J. Nelson Tunstall 30 Oct. 1967 52 p refs
(Contract W-7405-ENG-26)
(K-1724) CFSTI: HC $3.00/MF $0.65

A system of two linear first-order ordinary and two nonlinear second-order partial differential equations with mixed boundary condtions was considered. Solutions by both linear and nonlinear numerical methods are discussed and compared. The equations arise from a description of the simultaneous chemical reaction and convective–diffusive transport of water vapor and hydrogen through a graphite cylinder. Although specifically written for the steam-graphite system, the equations may have applications to general systems of fluid flow coupled with chemical reactions. Author (NSA)

N68-14139# California Univ., Berkeley. Lawrence Radiation Lab.
THEORETICAL ANALYSIS OF THE MOVING BOUNDARY MEASUREMENT OF TRANSFERENCE NUMBERS
Paul Milios (M.S. Thesis) Sep. 1967 57 p refs
(Contract W-7405-ENG-48)
(UCRL-17807) CFSTI: HC $3.00/MF $0.65

A moving boundary system was analyzed and an equation for the transference number derived. The equation is valid for concentrated as well as dilute solutions. When the partial molal volume of the solvent is constant through the boundary, the equation reduces to the approximate equation now in common use. The cation transference number in 0.213M NH_4NO_3 was experimentally determined and found to be equal to 0.5140±0.0024. Author (NSA)

N68-14141# Oak Ridge National Lab., Tenn.
CHEMISTRY DIVISION Annual Progress Report, Period Ending 20 May 1967
Sep. 1967 170 p refs
(Contract W-7405-ENG-26)
(ORNL-4164) CFSTI: HC $3.00/MF $0.65

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N68-14142# Oak Ridge National Lab., Tenn.
NUCLEAR CHEMISTRY
J. Halperin et al *In its* Chem. Div. Sep. 1967 p 1–23 refs (See N68-14141 05-06)

Thermal cross sections and resonance integrals were studied for Ba^{140}, Nb^{93} and Nb^{94}, and decay of Cm^{249} and half-lives of Pu^{242} and Pu^{244} are reported. Other isotope studies deal with recoil nuclei in C^{11} and N^{13}, alpha decay of the holmium nuclei, and identification of Nd^{138} and Nd^{137}. Decay properties of Tc^{98} and its independent yield in the thermal neutron induced fission of U^{235} is reported, and energies are given of some high energy gamma rays from the decay of Cl^{38}, La^{140}, and Pr^{144}. A search was made for members of the two-phonon triplets in Se^{80} and Kr^{80}, and band mixing from the beta bands of Sm^{152} and Gd^{154} was studied. Other nuclear chemistry research programs deal with gamma ray transitions in Mo^{92}, levels in Tc nuclei, design of an iron-free electron spectrometer, and detector arrangement and data acquisition by a low-level gamma ray spectrometer for lunar samples. M.W.R.

N68-14143# Oak Ridge National Lab., Tenn.
ISOTOPE CHEMISTRY
D. A. Lee et al *In its* Chem. Div. Sep. 1967 p 24–34 refs (See N68-14141 05-06)

Fractionation of lithium isotopes by extraction chromatography is reported; as are studies on solvent extraction of Li and Na ions by dibenzoylmethane–trioctylphosphine oxide systems, Li separation from other alkali metal ions by extraction chromatography, and boron isotope separation. Other studies deal with the fractionation of carbon isotopes with molecular addition compounds of CO, a liquid–liquid system for enrichment of carbon isotopes, and fractionation of carbon isotopes between CO and BH_3CO. Radiative reaction rates in the reduction of NO_3^-, NO_2^-, and NH_2OH to NH_3 isotope effects in the reduction of NO_3^- to NO_2^-, and oxygen isotope enrichment studies are also reported. Other summaries deal with Raman, infrared, and mass spectroscopy studies, including a laser-equipped Raman spectrophotometer. M.W.R.

N68-14144# Oak Ridge National Lab., Tenn.
RADIATION CHEMISTRY
J. A. Ghormley et al *In its* Chem. Div. Sep. 1967 p 35–45 refs (See N68-14141 05-06)

Flash photolysis and pulse radiolysis techniques are compared; and studies are reported on flash photolysis of liquid water, and flash photolysis and pulse radiolysis of both solids and oxygen. The nature of the precursor of molecular hydrogen in the radiolysis of water was investigated, geminate recombination in photochemistry as a first-order process was studied, and energy transfer in the radiolysis of organic compounds is described. Studies on the radiation and hot-atom chemistry of crystalline inorganic solids deal with Cl^{38g} recoils in neutron-irradiated $NaClO_3$, $KClO_3$, and $KClO_4$;

Br^{82g} recoils in neutron-irradiated crystalline alkali metal bromates; and I^{128g} recoils in neutron-irradiated crystalline KIO_3 and KIO_4.
M.W.R.

N68-14145# Oak Ridge National Lab., Tenn.
ORGANIC CHEMISTRY
V. F. Raaen et al *In its* Chem. Div. Sep. 1967 p 46–56 refs (See N68-14141 05-06)

Investigations are reported on the mechanism for pyrolysis of iron salts of aromatic carboxylic acids, photoinduced reactions of naphthoyl cyanide, preparation and hydrolysis of 5-exo-phenyl-5-hydroxy-2-exo-norbornyltosylate, and deamination of 3-exo-phenyl-3-hydroxy-2-endonorbornylamine. An analysis was made of available isotopic data for the solvolyses of 2-exo-norbornyl and 2-(Δ^3-cyclopentenyl)-ethyl esters, and shielding effects of the phenyl and hydroxyl groups were determined in phenyl-substituted norbornanols. Nuclear magnetic resonance spectra of allyl compounds, including rotational isomers of allyl alcohol and allyl esters were studied, as was photopolymerization with uranyl salts and tungsten light. Attention was given to the extraction of cations and of iron (III) with 2-ethylhexanohydroxamic acid.
M.W.R.

N68-14146# Oak Ridge National Lab., Tenn.
CHEMISTRY OF AQUEOUS SYSTEMS
M. H. Lietzke et al *In its* Chem. Div. Sep. 1967 p 57–82 refs (See N68-14141 05-06)

Thermodynamics of aqueous silver sulfate–lanthanum sulfate solutions and the thermodynamic properties of hydrochloric acid–lanthanum chloride mixtures were studied. Osmotic coefficients are reported for mixed perchlorate solutions and tungstosilicic acid. Studies on the physical chemistry of polyelectrolyte systems deal with the binding of quaternary ammonium ions by polystyrenesulfonic acid-type cation exchangers, near-infrared spectra of aqueous solutions of some tetra-n-alkylammonium bromides, and the Donnan equilibrium in cross-linked polystyrene cation and anion exchangers. Heat of exchange of iodide with chloride ions is reported on a unifunctional weak-base-type anion exchanger at 25°C, and ionic interactions in organic ion exchangers are compared with model electrolyte mixtures. Exchange of zinc with sodium ions in cation exchangers and osmotic coefficients of aqueous tri-n-alkylsulfonium halides are reported at 25°C. A water research program is concerned with hyperfiltration by dynamically formed membranes, activity coefficient of KCl in aqueous solution, and correlation of sea salt concentration with the electromotive force response of a cation-sensitive glass electrode.
M.W.R.

N68-14147# Oak Ridge National Lab., Tenn.
ELECTROCHEMICAL KINETICS AND ITS APPLICATION TO CORROSION
F. A. Posey et al *In its* Chem. Div. Sep. 1967 p 83–94 refs (See N68-14147 05-06)

Kinetics of the initiation of crevice corrosion of titanium as well as pit initiation on Ti in chloride solution are among the studies reported under electrochemical kinetic applications to corrosion. Effect of flow rate was studied on the efficiency of oxidation–reduction reactions in porous and tubular electrodes, and silver electrodes were considered for chloride analysis in saline waters. Experimental determination was made of the kinetics of the formation of anodic films, calculations were made of the crystal face effects in anodic film formation, and the electrochemical behavior of titanium and inorganic inhibitors of corrosion were studied.
M.W.R.

N68-14148# Oak Ridge National Lab., Tenn.
NONAQUEOUS SYSTEMS AT HIGH TEMPERATURE
A. S. Dworkin et al *In its* Chem. Div. Sep. 1967 p 95–100 refs (See N68-14141 05-06)

High temperature thermochemistry of the lanthanum chlorides was studied, and calorimetric evidence is presented for complexing in charge–unsymmetrical binary fused salt systems such as cadmium or magnesium dichloride–potassium chloride. Studies with molten salt–metal solutions deal with the EMF measurements in molten rare earth metal–metal halide solutions, alkali metal–metal halide miscibility in ternary systems, and solubility of metals in their molten fluorides.
M.W.R.

N68-14149# Oak Ridge National Lab., Tenn.
CHEMICAL PHYSICS
W. C. Waggener et al *In its* Chem. Div. Sep. 1967 p 101–144 refs (See N68-14141 05-06)

Effects of temperature on the near-infrared absorption spectra of molecules in condensed states are reported along with studies dealing with calorimetry, microwave and radio frequency spectroscopy, neutron and X ray crystallography, molecular beam studies, and mass spectrometry. Spectroscopy studies deal with the paramagnetic resonance of single crystals, free radicals formed in acetyl solutions during ultraviolet photolysis, and solutions of nitriles and hydrogen peroxide. Crystal and molecular structure of various compounds were studied investigated, and a segmented body thermal motion analysis program is reported. Use of stereoscopic drawings to illustrate the three-dimensional structure of a crystalline protein is described. Crossed molecular beam studies of the reactions of atomic deuterium with halogen molecules, collisional excitation of molecular hydrogen, and crossed-molecular beam studies are summarized. Decomposition of ammonia by ionizing radiation in a wide-range radiolysis source was studied by mass spectrometry, and mass spectrometric and theoretical evidence are included for NH_4 and H_3O.
M.W.R.

N68-14183# Bureau of Mines, Minneapolis, Minn.
KINETICS OF FORMATION OF CARBON DIOXIDE AND CARBON FROM CARBON MONOXIDE IN PRESENCE OF IRON PELLETS
Larry A. Haas, Sanaa E. Khalafalla, and Perry L. Weston, Jr. Jan. 1968 33 p refs
(BM-RI-7064)

A kinetic study of the carbon deposition reaction was undertaken as part of a broad investigation of metallurgical reactions in the iron ore blast furnace. The disproportionation of carbon monoxide on iron pellets was investigated at carbon monoxide pressures between 0.5 and 2 atmospheres (absolute) and temperatures from 400° to 1,075°C. Gas flow in the range from 0.25 to 0.85 standard liter per minute was found to have little effect on the reaction velocity. The addition of nitrogen and helium to carbon monoxide exerted only a dilution effect on the rates of carbon deposition. However, an addition of 1 percent hydrogen increased the rate about 100 times. Small amounts of carbon dioxide in the inlet gas exerted little effect on the rate of carbon deposition. The maximum rate for carbon deposition in the first 2 hours occurred at 550°C. The apparent molar activation energies at various stages of the reaction were found to vary from 13 kcal initially to 36 kcal during the latter stages of the reaction. The reaction rate behavior was tentatively explained by an adsorption step followed by the diffusion of iron through a shell of inactive iron carbide.
Author

N68-14190# Idaho Nuclear Corp., Idaho Falls.
BURNUP DETERMINATION OF NUCLEAR FUELS Quarterly Report, Oct. 1–Dec. 31, 1966
Frederick L. Lisman, ed., William J. Maeck, ed., and James E. Rein, ed. Oct. 1967 49 p refs
(Contract AT(10-1)-1230)
(IN-1113) CFSTI: HC$3.00/MF$0.65

The measurements of the absolute, thermal fission yields of stable Cs-133, 30.3y Cs-137 and the stable Zr-91, −92, −93, −94, and −96 isotopes for U-233 and U-235 by isotope dilution mass spectrometry are presented.
Author (NSA)

N68-14208# Aerojet-General Corp., Azusa, Calif.
PROCESS STUDIES ON FEFO Final Report, 10 Mar.–10 Sep. 1967
H. J. Marcus, F. E. Miller, and R. R. Rindone Oct. 1967 83 p refs Prepared for Calif. Univ., Lawrence Radiation Lab., Livermore
(Contract W-7405-ENG-48)
(Rept.-3466; UCRL-13315) CFSTI: HC$3.00/MF$0.65

The results of investigations into the methods of preparation of FEFO [bis(2-fluoro-2, 2-dinitroethyl)formal] and its intermediates, and the associated analytical methods, are described.
Author (NSA)

N68-14225# California Univ., Berkeley. Lawrence Radiation Lab.
HEAT OF SUBLIMATION AND THE EVAPORATION COEFFICIENT OF PRASEODYMIUM TRIFLUORIDE
Harry Bryant Skinner, Jr. (M.S. Thesis) Sep. 1967 22 p refs
(Contract W-7405-ENG-48)
(UCRL-17804) CFSTI: HC$3.00/MF$0.65

The sublimation pressure of praseodymium trifluoride was measured in the temperature range 1424 to 1586°K by the torsion-effusion and torsion-Langmuir methods. The equilibrium pressure is given in this temperature range by the expression Log $P_{Atm} = -(2.109 \pm 0.012)\ 10^4/T + 9.371 \pm 0.082$ where the quoted errors are the standard deviations from the least squares fit. The heat sublimation at 298.15°K was calculated to be 106.6 kcal/mole by the second law method and 103.3 kcal/mole by the third law method. Because the third law calculations are strongly dependent on estimated free energy functions, 106.6±5 kcal is set as the most probable value and uncertainty. Comparison of the Langmuir and Knudsen data yields an apparent evaporation coefficient of 1.00±.04. In consideration of the pitting and fissuring observed for Langmuir surfaces, the true evaporation coefficient is fixed as 0.9±0.1 for the (0001) face.
Author (NSA)

N68-14229 United Kingdom Atomic Energy Authority, Harwell (England). Analytical Sciences Div.
A CATALOGUE OF 30 MeV GAMMA ACTIVATION PRODUCTS. PART 1: SODIUM TO MOLYBDENUM
C. A. Baker, G. J. Hunter, and D. A. Wood Sep. 1967 49 p refs
(AERE-R-5547) HMSO: 7s

The elements Sodium to Molybdenum have been irradiated with 30 MeV gamma photons under specified irradiation conditions. Gamma spectra of the active products are presented together with a value for the specific activity, identification of the nuclides present and the nuclear reactions by which the products have been formed.
Author

N68-14230 United Kingdom Atomic Energy Authority, Amersham (England). Radiochemical Centre.
STUDIES OF THE EFFECTS OF RADIATION ON AQUEOUS SOLUTIONS OF 3:5-DIIODOTYROSINE
A. Appleby Jul. 1967 37 p refs
(RCC-R-209) HMSO: 5s

The self-decomposition of I-131 labelled 3,5-diiodo-L-tyrosine stored in aqueous solution is studied. The percentage decomposition for a given absorbed radiation dose is shown to be independent of specific activity over a wide range, and a marked protecting effect of dissolved oxygen is described. These and other effects are shown to be consistent with a postulated reaction mechanism in which the radiolytically produced hydrated electron is an important intermediary. The protecting capacities of a number of solutes are studied and correlated with their reactivities towards the hydrated electron.
Author

N68-14232 Bureau of Mines, College Park, Md.
METHODS FOR PRODUCING ALUMINA FROM ANORTHOSITE
Paul W. Johnson and Frank A. Peters Jan. 1968 48 p refs
(BM-RI-7068)

An evaluation is made of a lime-soda sinter process for extracting alumina from anorthosite. In this process, alumina is extracted by sintering anorthosite with soda ash and limestone, and then leaching the sinter with a dilute sodium carbonate solution. The sodium aluminate solution formed during leaching is separated from the residue and treated with lime in autoclaves to remove dissolved silica before alumina trihydrate is precipitated with carbon dioxide. The trihydrate is then calcined to α-alumina. The cost estimates of dry grinding and wet grinding to options used in the sintering process are presented. This process, when treating anorthosite, using either option, is not competitive under current economic conditions with the Bayer process treating bauxite to produce alumina.
Author

N68-14236# Kansas Univ., Lawrence. Dept. of Chemistry.
THERMODYNAMICS OF THE VANADIUM BORIDES
Karl E. Spear, Harold Schaefer (Muenster Univ.), and Paul W. Gilles 30 Sep. 1967 24 p refs Presented at 3d Intern. Symp. on High Temp. Technol., Pacific Grove, Calif., 17–20 Sep. 1967 Submitted for publication
(Contract AT(11-1)-1140)
(COO-1140-164; CONF-670935-3) CFSTI: HC$3.00/MF$0.65

Results of experiments to develop thermodynamic data for vanadium borides are reported. Two types of experiments were conducted: a heterogeneous equilibrium investigation of the ternary system V–B–N, and a vaporization study of the V–B system including mass-spectrometric measurements on VB_2. Experimental apparatus and procedures are described and the heats of formation of the most-oxidized borides, carbides, and oxides of Group IV and Group V elements are presented graphically. An extensive bibliography is included.
NSA

N68-14253# Idaho Nuclear Corp., Idaho Falls.
BLENDING RAFFINATES FROM ZIRCONIUM AND ALUMINUM PROCESSES
B. J. Newby and T. L. Hoffman Sep. 1967 13 p refs
(Contract AT(10-1)-1230)
(IN-1114) CFSTI: HC$3.00/MF$0.65

Raffinates from the reprocessing of both aluminum and zirconium alloy nuclear reactor fuels are produced and stored at the Idaho Chemical Processing Plant. The corrosion and stability to precipitation of a series of blends of these raffinates were evaluated to determine which blended compositions were usable and what storage conditions could be permitted. Several compositions containing 20 percent or less, and 90 percent or more zirconium raffinate were stable for one year. Zirconium fluoride hydrolysis products precipitated in the other blends. Both corrosion and solution stability were adversely affected by storage temperatures of 55°C compared to 35°C, and the latter temperature was recommended. At 35°C the corrosion of Types 304L and 347 stainless steel was acceptable for long-term use.
Author (NSA)

N68-14269# Oak Ridge National Lab., Tenn.
CALCULATED NEUTRON MULTIPLICATION FACTORS OF UNIFORM AQUEOUS SOLUTIONS OF ^{233}U AND ^{235}U
J. Wallace Webster Oct. 1967 39 p refs
(Contract W-7405-ENG-26)
(ORNL-CDC-2) CFSTI: HC$3.00/MF$0.65

Computations of the effective neutron multiplication factor of single units of aqueous solutions of $^{233}UO_2F_2$ and $^{235}UO_2F_2$ are reported for guidance in the specification of limits applicable to processes, such as storage and transport, for these fissile isotopes. Graphs are presented of k_{eff} as a function of such parameters as the mass of fissile material, the chemical concentration, the dimensions of spheres and infinitely long cylinders, and the thickness and areal density of infinite slabs. Transport theory (DTF)

codes in the S_n approximation with Hansen–Roach cross sections were utilized and the results agree with relevant experiments to within 0.01 in k_{eff}. Author (NSA)

N68-14287*# National Aeronautics and Space Administration, Washington, D. C.

AN APPARATUS FOR DIFFERENTIAL–THERMAL ANALYSIS OR ISOTHERMAL DECOMPOSITION WITH SIMULTANEOUS MASS-SPECTROMETRIC ANALYSIS [USTANOVKA DLYA PROVEDENIYA DIFFERENTSIAL'NOTERMICHESKOGO RAZLOZHENIYA S ODNOVREMENNYM ANALIZOM NA MASS-SPEKTROMETRE]

R. N. Isayev, Yu. A. Zakharov, and V. V. Bordachev Jan. 1968 4 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 41, 1967 p 2398–2399

(NASA-TT-F-11460) CFSTI: HC$3.00/MF$0.65 CSCL 07A

A description of a very simple system allowing the performance of analyses of the products of thermolysis in parallel with a study of the kinetics of isothermal decompositon or differential–thermal analysis of compounds. The device involves recording of the pressure of gases liberated with simultaneous sampling of gaseous products of decomposition for mass-spectrometric analysis. Author

N68-14318# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering and Process Technology Div.

EFFECT OF MOISTURE ON THE INHIBITORY ACTION OF PHOSPHORUS OXYCHLORIDE ON THE AIR OXIDATION OF GRAPHITE

J. B. Lewis, A. N. Moul, and R. Murdoch Jul. 1967 19 p refs

(AERE-R-5552) CFSTI: HC$3.00/MF$0.65

The effect of adding $POCl_3$ to the air stream when nuclear graphite is oxidized in air was examined by following the change in temperature of the graphite specimen. When the air was dry, $POCl_3$ produced a rapid and marked diminution in the rate of oxidation, but when moisture was present the inhibition was much less and was slow to develop. In some experiments with moist air, addition of $POCl_3$ produced an acceleration of the rate. The presence of steel in the proximity of the graphite had no effect. Author (NSA)

N68-14319# Genaral Electric Co., Pleasanton, Calif. Nuclear Technology Dept.

SODIUM MASS TRANSFER. 24: METHODS FOR SEPARATION AND IDENTIFICATION OF SODIUM IMPURITIES

D. Dutina and J. L. Simpson Mar. 1967 29 p refs

(Contract AT(04-3)-189)

(GEAP-5020) CFSTI: HC$3.00/MF$0.65

The development and use of special equipment and procedures for efficient recovery and sensitive identification of impurities from loop sodium is reported. Good recoveries of impurities such as iron, chromium, nickel, and calcium were demonstrated. Some of the chemical effects of the separations procedure on possible impurities were examined. Sealed-glass capillaries and vacuum-tight filter sample holders enable examination of impurities by nondestructive analytical methods. An inert atmosphere box was installed to handle samples and to encapsulate separated residues. A literature survey and an accumulation of patterns of possible impurity compounds was compiled. X-ray patterns of some impurities in dump tank sodium were identified. A study of the applicability of DTA-EGA (differential thermal analysis–effluent gas analysis) as a backup technique for characterization of the residue was initiated. Fabrication of a large sampling container to provide representative sodium from the program loops is underway. Author (NSA)

N68-14322# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

RADIOIODINE CONTROL DURING REPROCESSING OF SHORT-COOLED IRRADIATED ^{237}Np ALUMINUM ALLOY TARGET ELEMENTS (A PRELIMINARY STUDY)

W. O. Greenhalgh Apr. 1967 13 p refs

(Contract AT(45-1)-1830)

(BNWL-460) CFSTI: HC$3.00/MF$0.65

The chemistry of radioiodine was studied in the following process steps: dissolution of the Np–Al target in nitric acid with mercury catalyst and subsequent feed stream manipulation and storage; extraction of neptunium and plutonium by 30% TBP–NPH (normal parafin hydrocarbon); and absorption of neptunium and plutonium by Dowex 1 anion resin. Two percent or less of the total radioiodine was evolved during dissolution tests using an aluminum metal stand-in. Almost quantitative extraction of the feed stream radioiodine was exhibited by a 30% TBP–NPH batch contact. Greater than 90% of the feed stream radioiodine was absorbed by anion resin during one short column pass. Two methods (precipitation as mercuric iodide and extraction by phenyl mercuric acetate or phenyl mercuric nitrate in benzene) were found effective in removing feed stream radioiodine while only slightly affecting the neptunium content. NSA

N68-14336# Los Alamos Scientific Lab., N. Mex.

COLLECTED RADIOCHEMICAL PROCEDURES (RADIOCHEMISTRY GROUP J-11)

Jacob Kleinberg, comp. Sep. 1967 187 p ref 3d Edition Supersedes LA-1566; LA-1567; LA-1721, 1st Ed; LA-1721, 2d Ed; LA-1722

(Contract W-7405-ENG-36)

(LA-1721; LA-1566; LA-1567; LA-1722) CFSTI: HC $3.00/MF $0.65

The chemistry of the elements on the basis of electronic configuration is discussed. Separations and radiochemical techniques in the determination of Sh, As, Ba, Be, Bi, Cd, Ca, Ce, Cs, Cl, Cr, Co, Cm, Ge, Au, In, Fe, rare earths, Rh, Mg, Mn, Mo, Np, Ni, Nh, Pd, P, Pu, Pr, Rh, Ru, Sc, Ag, Na, Sr, sulfate, Ta, Te, Tl, Th, Sn, transactinides, W, U, Y, and Zr are presented. NSA

N68-14340# United Kingdom Atomic Energy Authority, Harwell (England). Analytical Sciences Div.

ANALYSIS OF SOME EXPERIMENTAL BINARY ALLOYS USING X-RAY FLUORESCENCE AND CHEMICAL METHODS

F. W. J. Garton, A. Parker, and J. Watling Aug. 1967 12 p refs

(AERE-R-5452) CFSTI: HC$3.00/MF$0.65

The X-ray fluorescence analysis of a number of binary alloys using an automated Philips PW 1520 X-ray spectrometer is described. Solution techniques were generally employed, although some applications using powders are also given. Satisfactory agreement was obtained with results from chemical methods of analysis. Data are tabulated. Author (NSA)

N68-14376# Oak Ridge National Lab., Tenn.

SAFETY STUDIES OF THE SHEAR-LEACH PROCESSING OF ZIRCALOY-2-CLAD SPENT NUCLEAR FUELS

G. A. West and C. D. Watson Oct. 1967 14 p refs

(Contract W-7405-ENG-26)

(ORNL-4061) CFSTI: HC$3.00/MF$0.65

A safety study of the handling of Zircaloy particles produced by a shear-leach processing of Zircaloy-clad nuclear fuels was conducted by means of a literature search and some abrasive disc sawing, shearing, and ignition tests. It was found that shear-leach processing can be accomplished safely. Dry zirconium powder is ignitable at room temperature by static electricity or simple friction and explodes spontaneously when dispersed into the air as a cloud. With a moisture content of 16% or less, it has on a few occasions

exploded spontaneously while under vacuum. Violent explosions, which have occurred and produced fatal injuries, involved powders finer than 62 μ, or finer than 230 mesh size. When the surface area per gram approaches 0.1 m^2, caution must be exercised in powder handling. Particles finer than 20 mesh (800 μ) and coarser than 120 mesh (125 μ) should be collected wet (under water) and mixed with an equal volume of sand or grinding wheel grit. Tests showed that sawing can be done safely, provided large quantities (more than 1 to 2 kg) of the particles are not allowed to accumulate in the system. The Zircaloy-2 particles diluted with abrasive particles from wet sawing (the preferred method) at a minimum of three parts by volume is considered safe to handle and store. Particles produced by shearing are not converted to the oxide. Those less than 149 μ can be ignited by a Tesla coil. Particles resulting from shearing should be settled out and collected, following the leaching step, and chemically dissolved. Author (NSA)

N68-14405# United Kingdom Atomic Energy Authority, Harwell (England).
THE PREPARATION OF SATURATED ^{63}Cu AND ^{65}Cu PERCHLORATE SOLUTIONS IN HEAVY WATER
K. C. Barnes, B. M. Maude, and K. L. Wilkinson Aug. 1967 4 p
(AERE-M-1948) CFSTI: HC $3.00/MF $0.65

The separation of gram quantities of ^{63}Cu and ^{65}Cu from copper tin alloys, and the subsequent preparation of their saturated perchlorate solutions in heavy water are described. Author (NSA)

N68-14410# Argonne National Lab., Ill.
ELECTROSYNTHESIS OF O_3. 11: METHOD FOR CONNECTING OZONIZERS
Yu. V. Filippov and V. P. Vendilo Sep. 1967 6 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 40, 1966 p 2337–2340
(ANL-TRANS-521) CFSTI: HC $3.00/MF $0.65

Using the theory of the effect of a transfer of reacting substances along a flow upon the reaction kinetics, it was shown that the increase of the operating efficiency of reactors at a consecutive connection depends on the occurrence of ozone transfer along the flow. The experimental data on ozone synthesis confirmed the advantage of a consecutive ozonizer connection along the flow which indicates the presence of an ozone transfer along the flow. Author (NSA)

N68-14415# United Kingdom Atomic Energy Authority, Harwell (England). Analytical Sciences Div.
THE DISTRIBUTION OF SOME TRACE ELEMENTS IN IRON METEORITES, AS DETERMINED BY NEUTRON ACTIVATION. PART 2: ANALYTICAL METHODS
A. A. Smales, D. Mapper, and K. F. Fouche Aug. 1967 20 p refs
(AERE-R-5254) CFSTI: HC $3.00/MF $0.65

The eleven trace elements Ge, Ga, As, Sb, Cu, Cr, Mo, Ag, In, Zn, and Pd, were determined in 67 iron meteorites, using neutron activation and radiochemical separations. The complete results were published and discussed (Geochim. Cosmochim. Acta 31, 673, 1967). A detailed account is given of the analytical methods used, including those used for some absorptiometric determination of gallium and sulfur. Author (NSA)

N68-14421# California Univ., Berkeley. Lawrence Radiation Lab.
ELECTRON SPIN RESONANCE STUDIES OF RADICALS PRODUCED BY ELECTROLYSIS
Carolyn L. Talcott (Ph.D. Thesis) Sep. 1967 124 p refs
(Contract W-7405-ENG-48)
(UCRL-17743) CFSTI: HC $3.00/MF $0.65

The ESR spectra of the radical anions of pyridine, pyrimidine, and pyrazine in liquid ammonia were measured. The coupling constants obtained from these spectra allowed values of the quantities Q^N_N, Q^N_{CN}, and Q^H_{CH} to be determined without relying on calculated spin densities. The values found are: $Q^N_N = +27.3$ gauss, $Q^N_{CN} = -1.7$ gauss, and $Q^H_{CH} = -24.5$ gauss. Theoretical values for the parameters Q^N_N (pyridine, pyridine N-oxide, nitrosobenzene, and nitrobenzene), Q^N_{CN}, and Q^H_{CH} were calculated using configuration interaction in a MO framework. The ESR spectra of several substituted pyridine radical anions in liquid ammonia are reported including: 4-picoline, 3,5-lutidine, pyridine N-oxide, 4-picoline N-oxide, and 2,6-lutidine N-oxide. A series of McLachlan type spin density calculations were carried out. Excellent agreement between experimental and calculated spin densities was obtained for the simple heterocyclics and for the methyl-substituted pyridines. The parameters for N-oxides were not as well determined. Author (NSA)

N68-14424# Colorado Univ., Boulder.
[ON INORGANIC CHEMISTRY] Progress Report
Harold F. Walton 11 Sep. 1967 5 p refs
(Contract AT(11-1)-499)
(COO-499-16) CFSTI: HC $3.00/MF $0.65

The order of elution of aliphatic diamines from nickel-sulfonic resins by ammonia was determined. Ethyleneimine derivatives, ethanolamine derivatives, purine and pyrimidine bases, and polyhydric alcohols were separated by ligand-exchange liquid chromatography. Studies are also being made of ligand-exchange gas chromatography and thin-layer chromatography. Thermodynamic studies were made of univalent–divalent ion exchanges. NSA

N68-14428# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
SINGULAR ORBITS IN THE PROBLEM OF TWO FIXED CENTERS: THE STARTING POINT FOR CLASSICAL THEORY OF CHEMICAL BONDS [SINGULARNE ORBITY W ZAGADNIENIU DWU NIERUCHOMYCH CENTROW; WYJSCIOWY PROBLEM KLASYCZNEJ TEORII WIAZAN CHEMICZNYCH]
M. Gryzinski 1967 68 p refs In POLISH
(INR-818/18/PP)

Solutions of the problem of two fixed centers and trajectories passing through the centers of forces are considered. Conditions necessary for existence of closed trajectories were determined and basic types of closed trajectories are discussed. Possibilities of existence of balanced systems, that is, systems with closed trajectories for which the values of the forces acting on the centers averaged over the period of motion are equal to zero, and therefore admit the stability of physical systems with finite masses of both centers such as the ionized molecule of hydrogen, are considered. Author

N68-14445# European Atomic Energy Community, Brussels (Belgium).
THE INFLUENCE OF MASS TRANSFER ON THE KINETIC OF GRAPHITE OXIDATION BY LOW CONCENTRATION OF OXIDISING IMPURITIES IN AN INERT CARRIER GAS
L. J. Valette 1967 203 p
(EUR-2762. e)

Investigations have been carried out in the research and development program of DRAGON in order to find out the reaction rates of chemical impurities present in helium with graphite at high temperature. In the temperature range to be expected in a high temperature graphite cooled reactor the reaction rates can be mass transfer controlled. A pressurized loop has been built in order to investigate the mass transfer controlled reactions. The experimental investigations are correlated with theoretical predictions based on the boundary layer concept. In most cases a good prediction of

the rates can be achieved by these theories and in the remaining cases a good insight in the mechanism of the mass transfer could be obtained by the analysis of the boundary layers surrounding the reacting body. Author

N68-14476 Commissariat a l'Energie Atomique, Saclay (France).
PILOT WASTE PROCESSING PLANT FOR THE RECOVERY OF CAESIUM-137. BUTO PROJECT [INSTALLATION PILOTE DE TRAITEMENT D'EFFLUENTS POUR LA RECUPERATION DU CAESIUM 137. PROJET BUTO]
J. Fradin Brussels EURATOM Oct. 1967 115 p In FRENCH
(Contract EURATOM-025-62-10 RISF)
(EUR-3625.F)

The aim of the project is to construct a pilot appliance capable of ion-exchange separation of caesium-137 from acid waste. By means of this plant, the salient features of which are its simplicity and versatility, it is possible to study new mineral exchangers and to carry out any ion-exchange operation affecting radioactive waste. The project contains a description of the plant, the chemical equipment and the actuation, measuring, regulatory and control devices. Author

N68-14478* Los Alamos Scientific Lab., N. Mex.
THE SCANDIUM-CARBON SYSTEM
H. Rassaerts, H. Nowotny, G. Vinck, and F. Benesovsky [1967] 8 p refs Transl. into ENGLISH from Monatsh. Chem. (Vienna), v. 98, no. 2, 1967 p 460-468
(LA-TR-67-78; Rept.-1) CFSTI: HC $3.00/MF $0.65

Analytic data and results of X-ray diffraction studies of 8 samples of scandium carbides are reported. The specimens examined were prepared from powdered Sc and reactor-grade graphite and sintered at 1200 and 1350°C. The C content of the mixtures before heating varied from 10.5 to 39 at. %. X-ray analysis of the sintered carbides showed the existence of several phases including Sc_2C_3, Sc + $Sc_{2-3}C$, and $Sc_{2-3}C$, as well as a phase possibly of the Pu_2C_3 type. Assignment of indices was not successful but it was concluded that a series of peritectic reactions takes in the Sc-C system during sintering. NSA

N68-14479* Argonne National Lab., Ill.
ELECTROSYNTHESIS OF O_3. 1: KINETICS OF THE SYNTHESIS OF O_3 UNDER FLOW CONDITIONS
Yu. V. Filippov and Yu. M. Emel'yanov Sep. 1967 14 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 35, no. 2, 1961 p 407-415
(ANL-TRANS-522) CFSTI: HC $3.00/MF $0.65

It has been shown that equations employed for describing the kinetics of ozone synthesis correspond to the limiting cases of development of transport of the reactants along the stream during reaction under flow conditions. A general kinetic equation was derived that is in good accord with the experimental data. A method is presented for determining the true decomposition and formation constants of ozone on reaction in flow. A principle for chemical reactions in electrical discharges was introduced according to which the kinetic constants are proportional to the volumetric discharge energy. Author (NSA)

N68-14482* Mellon Inst., Pittsburgh, Pa. Radiation Research Labs.
[ON CHEMISTRY] Quarterly Report, 1 Jul.-30 Sep. 1967
10 Oct. 1967 16 p *In* Fundamental Res. No. 6041
(Contract AT(30-1)-2310)
(RRL-2310-214) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on: Spiro Meisenheimer complexes derived from 1-(β-hydroxyethoxy)-2,4-dinitroarenes; Meisenheimer complexes of 1-alkoxy-2,4-dinitronaphthalenes; radicalinduced hydroxylation of nitrobenzene in dilute aqueous solution; solvated electron spectrum in irradiated ice; ESR spectra of photolytically produced radicals in SF_6 matrices; ESR-transient radicals in irradiated aqueous solutions; photolysis of CF_3OOCF_3; theoretical consideration of hyperfine splittings in the PF_4 radical; combination and disproportionation of alkyl radicals in liquid methane; electron scavenging in irradiated cyclohexene solutions; effects of negative-ion scavengers on the efficiency of positive ion reactions; gas phase radiolysis of benzene-nitrous oxide mixtures; competitive electron scavenging in irradiated hydrocarbon gases; Hg ($^3P_1$) photosensitized decomposition of cyclopropane; radioinduced hydroxylation of anisole in dilute aqueous solutions; hydrolysis of nitrosubstituted aryl sulfates; photochemical determination of relative rate constants for hydroxyl radical reactions; transient solvated electron and hydroxyl radical in pulse irradiated ice; and mass spectrometry of discharge flow system N_2+CH_4. NSA

N68-14498* Bureau of Mines, College Park, Md.
EXTRACTION OF 8-HYDROXYQUINOLINE COMPLEXES OF TRACE ELEMENTS FROM TUNGSTEN SOLUTIONS
Thomas E. Green Feb. 1968 20 p refs
(BM-RI-7072)

A solvent extraction procedure using 8-hydroxyquinoline and chloroform was investigated as a preconcentration technique for the determination of aluminum, calcium, cobalt, copper, iron, lead, magnesium, manganese, nickel, and zinc in large samples of high purity tungsten. X-ray spectrographic and atomic absorption methods were used to determine the trace metals after preconcentration. The presence of 10 grams of tungsten had a pronounced effect on the distribution of 8-hydroxyquinoline between the aqueous and chloroform phases. This change in the 8-hydroxyquinoline distribution in turn has an adverse effect on the extraction of the trace metals. Extraction efficiencies can also be adversely affected by an increase in the quantity of extractable metals present, as shown by radiotracer tests using ^{65}Zn. Excess 8-hydroxyquinoline in the extracts did not interfere with the determination of the extracted metals by atomic absorption, but caused serious interference in the combined ion exchange paper-X-ray spectrographic method. Author

N68-14518* Columbia Univ., New York. Dept. of Chemistry.
SEPARATION OF ISOTOPES Annual Progress Report
20 Sep. 1967 343 p refs
(Contract AT(30-1)-755)
(CU-755-4) CFSTI: HC $3.00/MF $0.65

Progress reports are presented for eight studies: (1) solvent carrier method for separation of ^{13}C and ^{18}O isotopes by chemical exchange of carbon dioxide with amine carbamates in non-aqueous solutions; (2) dual temperature process for concentrating deuterium by methylacetylene and hydrogen sulfide exchange reactions with water; (3) separation of heavy water using the isotope exchange reaction between methylacetylene and water; (4) preparation of 99.5 percent nitrogen 15 by chemical exchange between oxides of nitrogen in a solvent carrier system; (5) holdup of liquid phases on packing materials for exchange columns; (6) separation of isotopic molecules of nitric oxide by gas chromatography; (7) concentration of ^{13}C and ^{18}O by exchange of CO_2 and amine carbamates in a solvent carrier system; and (8) concentration of deuterium by the exchange between methylacetylene and water in a dual temperature system. E.C.

N68-14533* Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany). Abteilung Strahlenphysik.
STUDIES ON DIFFERENCE-γ-SPECTROMETRY [UNTERSUCHUNGEN ZUR DIFFERENZ-γ-SPEKTROMETRIE]
F. K. Altenhein Aug. 1967 119 p refs In GERMAN
(HMI-B-59)

Difference-γ-spectrometry is investigated experimentally and theoretically. Difference-γ-spectra are computed by the Monte-Carlo method and with experimental results for the scintillator

combinations NaI/anthracene and NaI/plastic NE 102 A. The optimum arrangement of a difference-γ-spectrometer is discussed. Author (NSA)

N68-14534# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany). Sektor Kernchemie.
CHEMICAL ASPECTS OF REACTOR SAFETY (LITERATURE REVIEW). FIRST SEMIANNUAL REPORT ON BEHALF OF THE GOVERNMENT MINISTRY FOR SCIENTIFIC RESEARCH [CHEMISCHE ASPEKTE DER REAKTOR-SICHERHEIT (LITERATURUEBERSICHT). 1. HALBJAHRESBERICHT IM AUFTRAG DES BUNDESMINISTERIUMS FUER WISSENSCHAFTLICHE FORSCHUNG]
E. Hoinkis Aug. 1967 48 p refs In GERMAN
(HMI-B-64)

A literature survey of the chemical aspects of reactor safety is presented. A discussion on fission product release and transport is presented with 23 references. Adsorption, release, and transport of fission product iodine are discussed; 22 references are given. Three references are included with an outline of work on aerosol filtration. Results of research on reactions of various metals with water are described; 8 references are given. Oxidation of graphite by steam and various aspects of corrosion are discussed; 16 references are presented. Reactions of fuel materials with water, steam, air and carbon dioxide are summarized; 10 references are given. Chemical problems associated with the handling of sodium coolants are discussed; 20 references are given. NSA

N68-14535# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany). Sektor Kernchemie.
STUDIES ON THE BEHAVIOR OF CRYSTALLINE SILICATE ION EXCHANGERS AND THEIR APPLICATION IN NUCLEAR TECHNOLOGY [BEITRAEGE ZUR KENNTNIS UND ZUR KERNTECHNISCHEN ANWENDUNG KRISTALLINER SILICAT-IONENAUSTAUSCHER]
Hans Wolfgang Levi Oct. 1967 126 p refs In GERMAN
(HMI-B-54)

The mobility of alkali metal and alkaline earth ions in vermiculite, montmorillonite, and synthetic zeolites and their effect on the ion-exchange behavior of these materials were studied. Particular attention is given to the phenomenon of fixation. Practical applications for production of radionuclides and the treatment of radioactive wastes are discussed. Author (NSA)

N68-14538# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.
MOESSBAUER EFFECT STUDIES ON Kr^{83} IN BROMIDE AND BROMATE CRYSTALS
M. Pasternak and T. Sonnino Jul. 1967 22 p refs
(IA-1132)

Moessbauer effect studies were performed using ^{83}Kr sources produced by the β^- decay of ^{83}Br in various bromine compounds. Experiments were done with LiBr, NaBr, KBr, CsBr, NH_4Br, $KBrO_3$ and Kr-β-hydroquinone sources at 90°K using a solid krypton absorber at 22°K. No isomer shift was observed for any of the sources indicating that the Kr outer configuration is not perturbed by the induced dipole interaction with its neighbors. No "KrO_3" species was detected as a result of the β^- decay of Br in $KBrO_3$. Broad and symmetric emission lines were observed for the Kr-hydroquinone, bromides, and bromate, the line width increasing in that order. This broadening is explained on the basis of the formation of a local distorted crystalline field, as a consequence of the internal conversion process of ^{83m}Kr. From the fact that a symmetric line is observed it has been concluded that at least two modes of distortion are formed in such a way so as to produce opposite signs in the electric field gradient. The Debye temperature calculated for the alkali bromide sources was found to be 60°K on the average, and for NH_4Br to be 90°K. The techniques of source preparation and of the krypton absorber deposition are described. Author (NSA)

N68-14540# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Chemistry.
DETERMINATIONS OF ELEMENTARY REACTION RATE CONSTANTS FOR THE REACTIONS OF HYDROGEN ATOMS WITH VARIOUS SUBSTRATE MOLECULES IN THE GAS PHASE Annual Progress Report, 1966–1967
J. V. Michael 1 Oct. 1967 30 p refs
(Contract AT(30-1)-3794)
(NYO-3794-1) CFSTI: HC$3.00/MF$0.65

Experimental measurements of quantities needed to determine the oscillator strength of the $^2P_{3/2,1/2} \leftarrow {}^2S_{1/2}$ transition in the hydrogen atom are described. The data were obtained for a lamp with an emitting thickness of 1.5 cm. The technique of Lyman α photometry was demonstrated to be one of the most sensitive methods available for detection of ground-state hydrogen atoms. NSA

N68-14552# California Univ., Livermore. Lawrence Radiation Lab.
THERMODYNAMIC STABILITY CONSTANTS OF ORGANIC/METAL-ION COMPLEXES
Esther D. Fultz 20 Feb. 1967 63 p
(Contract W-7405-ENG-48)
(UCRL-50200) CFSTI: HC$3.00/MF$0.65

Values of the formation constants of organic metal-ion complexes were compiled from experimental data. Tables of these thermodynamic stability constants constitute the main section of this report. Some conclusions regarding the preference of metal ions for various donor atoms of the ligand, and the effect of chelation on the stability of the complex are also presented. Author (NSA)

N68-14557*# Battelle Memorial Inst., Columbus, Ohio. Electronics Research Center.
HIGH TEMPERATURE MATERIALS STUDY
F. J. Reid, S. E. Miller, and R. D. Baxter Jun. 1967 29 p refs
(Contract NAS-12-107)
(NASA-CR-86021) CFSTI: HC$3.00/MF$0.65 CSCL 11B

A vapor-growth reactor system containing only ceramic parts in the high-temperature regions of the system was designed and put into operation. The deposits of AlP grown in this system consistently contained lower concentrations of impurities than did the deposits grown in a system containing quartz parts. The AlP has been characterized by emission-spectrographic analyses and by electrical-properties studies. It has been apparent that the inclusion of oxygen during a preparation has an effect on the electrical properties of the resulting AlP layer. High-resistivity (>100 ohm-cm) material has been prepared by the addition of oxygen. In general, the AlP contains free-electron concentrations on the order of $1 \times 10^{18}/cm^{-3}$, and electron mobilities as large as 80 cm^2/volt-sec have been obtained. This is the best combination of carrier concentration and mobility ever reported for AlP. Author

N68-14581# European Atomic Energy Community, Geel (Belgium). Central Bureau for Nuclear Measurements.
THE PRECISE AND ACCURATE DETERMINATION OF LITHIUM HYDROXIDE SOLUTIONS
J. Pauwels, Y. Le Duigou, and K. F. Lauer Brussels Dec. 1967 28 p refs
(EUR-3656.E)

Four methods for the precise determination of lithium hydroxide solutions have been compared: the acid-base titration with hydrochloric acid, the acid-base titration with benzoic acid, the weighing as sulphate and the weighing as carbonate. For the determination of a 0.1 M solution the agreement between the four results was better than 0.02%. Author

N68-14582*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
[A BROAD PROGRAM OF RESEARCH IN THEORETICAL CHEMISTRY] Semiannual Progress Report, 1 Jul.–31 Dec. 1967
(Grant NsG-275-62)
(NASA-CR-91663; Rept.-11) CFSTI: HC $3.00/MF $0.65 CSCL 07D

The application of quantum mechanics and statistical mechanics to biological and chemical problems is discussed. Work progress is reported for activities concerning: 1) molecular beam scattering, 2) transport phenomena in gases, 3) theories of intermolecular forces, 4) wave function calculations for spin densities, 5) magnetic interactions, 6) time-independent S-matrix theory of rotational excitation of diatomic molecules by atomic impact, 7) nuclear spin and collisions, 8) atom–atom and ion–atom elastic scattering, 9) perturbation equation solutions, 10) resonances, 11) quenching phenomena, and other aspects of chemical bonding. L.S.

N68-14600# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
EXPERIMENTS ON CHEMISTRY OF ELEMENT 104: KURCHATOVIUM. 1: DEVELOPMENT OF A METHOD FOR INVESTIGATION OF SHORT-LIVED ISOTOPES
I. Zvara, Yu. T. Chuburkov, T. S. Zvarova, and R. Caletka 1967 19 p refs
(JINR-D6-3281)

Physicochemical principles were investigated in a method for continuous separation and rapid chemical identification of isotopes of some transition elements produced in nuclear reactions by heavy ions. The method is based on the different volatilities of separated anhydrous chlorides of the elements and on different adsorbabilities of their molecules on solid surfaces. By performing experiments on separation of hafnium from lanthanide element isotopes and other products of nuclear reactions, conditions were chosen for comparison of element 104 properties with those of hafnium, known transplutonium elements, and other elements. Author (NSA)

N68-14606# California Univ., Berkeley. Lawrence Radiation Lab.
CHEMICAL BIODYNAMICS Annual Report, 1966
M. Calvin 1 May 1967 80 p refs
(Contract W-7405-ENG-48)
(UCRL-17520) CFSTI: HC $3.00/MF $0.65

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8. PHOTOSYNTHESIS BY ISOLATED CHLOROPLASTS R. G. Jensen and J. A. Bassham p 40–43 refs (See N68-14614 05-04)

9. PHOTOSYNTHESIS BY ISOLATED CHLOROPLASTS. 2: DISTRIBUTION OF ^{14}C-LABELED PRODUCTS BETWEEN CHLOROPLASTS AND SUPERNATANT SOLUTION J. A. Bassham, R. G. Jensen, and M. Kirk p 44–48 refs (See N68-14615 05-04)

10. SEARCH FOR δ-AMINOLEVULINIC ACID AS A PRODUCT OF METHANE–AMMONIA–WATER IRRADIATION M. A. Smith, A. Choughuley, and R. M. Lemmon p 77–79 refs (See N68-14616 05-04)

N68-14607# California Univ., Berkeley. Lawrence Radiation Lab.
CHEMICAL BONDING INFORMATION FROM PHOTOELECTRON SPECTROSCOPY
C. S. Fadley, S. B. M. Hagstroem, J. M. Hollander, M. P. Klein, and D. A. Shirley *In its* Chem. Biodyn. 1 May 1967 p 2–8 refs (See N68-14606 05-06)

In this paper we report some observations on the chemical shifts of core electron binding energies in iodine and europium compounds and indicate that these shifts may be explained in terms of two approximate theoretical models. Finally, we discuss briefly a few of the potential applications of this spectroscopic method to problems in coordination chemistry, biochemistry, and solid-state physics. Author

N68-14608# California Univ., Berkeley. Lawrence Radiation Lab.
FOURIER TRANSFORM NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY
Melvin P. Klein and Donald E. Phelps *In its* Chem. Biodyn. 1 May 1967 p 9–10 refs (See N68-14606 05-06)

A transform technique, in which free induction decay follows a short, intense radio frequency pulse, is proposed for nuclear magnetic resonance spectroscopy of biologically significant molecules which have previously eluded observation or yielded spectra with inadequate signal to noise ratios. Since the entire spectrum is generated for each pulse, and because the pulses may be repeated at intervals of several seconds, the efficiency of time usage is increased. Conventional field-swept nuclear magnetic resonance spectra of phosphorus 31 are compared with the impulse response following a single 90° pulse to the phosphorus 31 nuclei to illustrate the time saving possible with the proposed technique. E.J.S

N68-14609# California Univ., Berkeley. Lawrence Radiation Lab.
PRODUCT INVENTORY IN THE RADIOLYSIS OF CRYSTALLINE CHOLINE CHLORIDE
Margaret Ackerman and Richard M. Lemmon *In its* Chem. Biodyn. 1 May 1967 p 11–14 refs (See N68-14606 05-06)

A quantitative study was made of all detectable products that appear when the extraordinary radiation sensitive organic crystal, choline chloride, is exposed to gamma radiation. Besides the known major products, trimethylamine and acetaldehyde, only trace amounts of other products are detectable. The total yield of these is not more than 3% of the decomposed crystal. These results emphasize the very specific nature of the radiolysis mechanism. Author

N68-14610# California Univ., Berkeley. Lawrence Radiation Lab.
IDENTIFICATION OF SOME NEW PRODUCTS FORMED BY THE IRRADIATION OF SOLID BENZENE WITH ACCELERATED C^{14+} IONS
Helmut Pohlet, Wallace Erwin, Tz-Hong Lin, and Richard M. Lemmon *In its* Chem. Biodyn. 1 May 1967 p 15–17 refs (See N68-14606 05-06)

The chemical interactions of accelerated carbon 14 ions with benzene are investigated, and it is shown that diphenylmethane,

phenylcycloheptatriene, and phenylacetylene are products appearing after benzene on gas–liquid chromatographic tracings. Other data are interpreted to be compatible with the presence of benzocyclopropene or another of three possible isomeric bicycloheptatrienes. The experimental procedure for irradiating solid benzene with accelerated carbon 14 ions is described. E.J.S.

N68-14662 Environmental Science Services Administration, Boulder, Colo.
LINE PARAMETERS FOR THE 1.9 AND 6.3 MICRON WATER VAPOR BANDS
William S. Benedict (Johns Hopkins Univ.) and Robert F. Calfee Washington, D. C. Jun. 1967 208 p refs *Its* Professional Paper no. 2

The positions, intensities, and half-widths of the spectral lines in the $\nu_2\nu_3$, $\nu_1\nu_2$, and $3\nu_2$ bands of the 1.9μ region and the ν_2 band at 6.3μ are listed and identified for values of J as high as J=20. "Hot-line" transitions for the 021–010, 100–010, 020–010, and 001–010 bands are included. Lines attributed to the H_2O^{17} and H_2O^{18} isotopic molecules were also calculated. The list also includes HDO lines in the ν_2 bands. Particular consideration is given to interaction effects. Author

N68-14686# Institutt for Atomenergi, Halden (Norway).
WATER CHEMISTRY RESEARCH AT THE HALDEN BOILING HEAVY WATER REACTOR (HBWR)
L. Hammar, G. M. Allison, A. R. Anderson, F. Carlson, K. Fjellestad et al Jun. 1967 149 p refs
(HPR-55)

A water chemistry program at the Halden Boiling Water Reactor (HBWR) was carried out to investigate the radiolysis of water in this type of system with emphasis on reducing net water decomposition by deuterium addition and on the use of ammonia for alkalinity control. Another main objective was to investgate the influence of water chemistry and reactor parameters on the level of ^{16}N activity in the steam. The experiments were performed at reactor powers ranging from 5 to 20 MW, corresponding to average exit steam qualities between 1.2 and 4.2%, and at pressures between 10 and 29 ata (180 to 230°C). The net rate of water decomposition amounted to between 5 and 10 ml O_2 (STP) per kg of steam. The formation of radiolytic gas was largely confined to the boiling water within the fuel channels. The concentration of radiolytic gas in the moderator was of the order of 0.05 ml O_2 per kg and increased only slightly with power. The extent of water decomposition was affected by operating conditions in a way indicating that, under normal operating conditions of the reactor, significant recombination of primarily formed decomposition products occurs in the liquid phase in combination with stripping of these products into the steam. Author (NSA)

N68-14727# Arizona State Univ., Tempe.
THE SOLID STATE CHEMISTRY OF RARE EARTH OXIDES Technical Progress Report, 1966–1967
Leroy Eyring, Michael S. Jenkins, James O. Sawyer, Volker Scherer, Theron L. Felmlee et al 10 Jul. 1967 209 p refs
(Contract AT(11-1)-1109)
(COO-1109-25) CFSTI: HC$3.00/MF$0.65

Various studies on phase transformations, surface exchange reactions, X ray diffraction spectra, and crystal growths of rare earth oxide systems are reported. Main emphasis centered on the lanthanide elements, the praseodymium oxide–oxygen system, samarium, and neodymium sesquioxide. G.G.

N68-14751 Joint Publications Research Service, Washington, D. C.
SOVIET RESEARCH IN HIGH-ENERGY CHEMISTRY
17 Jan. 1968 16 p Transl. into ENGLISH from Khim. Vysokikh Energiy (Moscow), v. 1, no. 6, 1967 p 515–523
(JPRS-44048) CFSTI: $3.00

Recent progress in the various areas of high energy chemistry are briefly described. The basic problems are identified as studying the mechanisms of complex reactions, creating new chemical processes and improving existing ones, and developing powerful and efficient sources of high energy particles. Activities are reviewed in the fields of radiation chemistry, photochemistry, plasma chemistry, chemistry of shock waves, chemistry of the ionosphere, and nuclear chemistry. N.E.N.

N68-14756# Atomic Power Development Associates, Inc., Detroit, Mich.
AEC-SPONSORED ACTIVITIES Quarterly Technical Progress Report, Mar. 15–Jun. 15 1967
15 Jun. 1967 113 p refs
(Contract AT(11-1)-865)
(APDA-208) CFSTI: HC$3.00/MF$0.65

Progress is reported for projects including: Na-water reaction studies; H_2 behavior in the Na technology loop; A-scan and C-scan tests with narrow-beam ultrasonic transducers in Na at 600°F; and equations of state of UC and U alloy. NSA

N68-14760# Utah Univ., Salt Lake City. Inst. of Metals and Explosives Research.
LOW TEMPERATURE SHRINKAGE OF THORIA GEL. 1: KINETICS
R. K. Chang, F. A. Olson, and M. E. Wadsworth 31 Jan. 1967 74 p refs Prepared for Oak Ridge Natl. Lab.
(Contract W-7405-ENG-26)
(TID-24086; TR-31) CFSTI: HC$3.00/MF$0.65

The rate of desorption of chemisorbed gases, primarily NO_2, H_2O, and CO_2, from pressed thoria gel pellets was measured by means of the isothermal length decrease of the pellets as a function of time at various temperatures from 25 to 500°C. A kinetic equation based on a fundamental model of the relationship between weight change and length change for an isotropic solid and employing an activation free energy dependent on coverage of the surface by the chemisorbed gases was developed and obeyed by the experimental results. The variation of activation free energy with surface coverage resulted from variations of the activation enthalpy rather than the activation entropy. Values of 11.7 kcal/mole with complete surface coverage and 36.3 kcal/mole for zero coverage were measured for the activation enthalpy, while the activation entropy was −19.5 e.u. The dependence of desorption rate on temperature and hence on coverage was so great that about one-fourth to one-third of the chemisorbed species still remained at T=500°C. The maximum desorption rate of chemisorbed species was at about 350°C on the basis of these results. Physically adsorbed species, primarily water, were removed up to about 150 to 200°C. Removal of these species did not follow the kinetic desorption equation, which was obeyed by the chemisorbed species. Outgassing above about 150 to 200°C produced a gel that was non-dispersible in water, whereas the gel dispersed readily in water when outgassed below this approximate temperature. Author (NSA)

N68-14782 Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
IRRADIATED FUEL REPROCESSING BY VOLATILIZATION METHODS—REGENERATION OF CERAMIC FUELS [RETRAITEMENT DU COMBUSTIBLE IRRADIE PAR VOLATILISATION—REGENERATION DE COMBUSTIBLES CERAMIQUE] Final Report
Brussels EURATOM Dec. 1967 134 p refs In FRENCH; ENGLISH summary
(Contract Euratom-004-64-4-RCIB)
(EUR-2882.F; (EURAEC-1694)

Both chlorine trifluoride and fluorine can be used for the reprocessing of ceramic fuel in mixed-oxide form (U, Pu)O_2. The former, apart from its ability to convert the compact uranium dioxide directly into hexafluoride, also reacts with powdery fuel. In

none of the technological experiments carried out did it give rise to caking of the powders. Chlorine trifluoride is therefore a reagent which lends itself well to the various forms the fuel may assume after irradiation and decladding. Valuable technological data were also obtained concerning a reaction scheme in which fluorine was used for the simultaneous volatilization of uranium and plutonium. A hot semi-pilot plant for the evaluation of the two above-mentioned reprocessing cycles is under construction. A series of experiments was undertaken with the aim of facilitating the operation or increasing the safety of this plant. Research was conducted on the pulverization conditions for uranium carbide with a view to the subsequent formation of hexafluoride. Also the direct reaction between uranium monocarbide and chlorine trifluoride has been investigated. The problem of converting uranium and plutonium fluorides into oxides was examined. Author

N68-14786 Joint Publications Research Service, Washington, D. C.
SYNTHESIS OF KURCHATOVIUM
G. N. Flerov and V. I. Kuznetsov 17 Jan. 1968 24 p refs
Transl. into ENGLISH from Priroda (Moscow), no. 11, Nov. 1967 p 35–44
(JPRS-44045) CFSTI: $3.00

A historical review of physical and chemical events leading to the synthesis of the 104th element of the periodic system, kurchatovium, is presented. The works of Bohr and Rutherford; the development of the quantum theory; and the work of Fermi and Seaborg, are noted. Heavy ion bombardment experiments, the synthesis and identification of the 102nd element, and other milestone events leading up to the synthesis of kurchatovium are described. The experimental method and apparatus used in synthesizing kurchatovium, the nuclear reaction between plutonium and neptunium, and the chemical identification of the element, are described. Implications in the search for other elements above kurchatovium are outlined. L.S.

N68-14800# Cornell Univ., Ithaca, N. Y.
INFRARED ABSORPTION OF SUBSTITUTIONAL IMPURITIES IN ALKALI HALIDES
Tseng Chu Tak (Ph.D. Thesis) Jun. 1967 96 p refs
(Contract AT(30-1)-3699)
(NYO-3699-17) CFSTI: HC $3.00/MF $0.65

In the study mainly low concentration cases were considered where the impurities have no internal degrees of freedom. The discussion is confined to the harmonic approximation. Lattice dynamics and symmetry properties of perfect and imperfect crystals are considered. Perfect and imperfect Green's functions, localized perturbations in imperfect crystals, and ionic impurity vibrations in alkali halide crystals are discussed. Green's functions in NaI were computed. Selection rules of infrared absorption in imperfect alkali halides are discussed and the results compared with observed data. NSA

N68-14880# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
VAPORIZATION OF VARIOUS ACTINIDE COMPOUNDS. 3. VAPORIZATION OF CERTAIN URANIUM COMPOUNDS [VYPAROVANI AKTINIDU A JEJICH SOLUCENIN. 3. VYPAROVANI NEKTERYCH SLOUCENIN URANU]
I. Krivy Mar. 1967 48 p In CZECH
(UJV-1783)

The vaporization of some binary compounds of uranium, namely oxides, sulfides, nitrides, phosphides, carbides, silicides, germanides, borides, and intermediate compounds of uranium with Bi, Sn, Pb, Ga, In, and Zn is discussed. A survey and the critical evaluation of all available papers in the field up to the end of the first half of the past year is included, particular attention being paid to the compounds of interest in nuclear reactor technology. For each two-component system (e.g., oxides, carbides, etc.) fundamental data are given on: crystal structures, composition of the vapor over the condensed phases (at least qualitatively) together with the dependence on the experimental conditions; and, the results of tensimetric experiments usually given in the form log $P=f(T)$. The values of dissociation energy for the gaseous species or those of standard free energy of formation for the individual condensed phases (ΔG_f°) are presented provided that they are derived on the basis of tensimetric data. Author (NSA)

N68-14906# TRW Systems Group, Redondo Beach, Calif.
STUDY OF THE CHEMICAL INTEGRITY OF RADIOISOTOPE CONTAINMENT MATERIALS IN LAUNCH ABORT ENVIRONMENTS. PHASE 3, TASK 1: THE BEHAVIOR OF CONTAINMENT MATERIALS IN HYDROGEN–FLUORINE FLAME ENVIRONMENTS Summary Technical Report
W. Gregson, Jr., J. R. Ogren, and R. C. Ham Jun. 1967 93 p
Prepared for Sandia Corp.
(SC-CR-67-2656) CFSTI: HC $3.00/MF $0.65

The behavior of four nuclear containment materials (Type 316 stainless steel, Hastelloy C, Haynes alloy 25, and tantalum) in simulated abort fires containing large concentrations of fluorine and hydrogen fluoride were investigated. Samples were exposed to hydrogen–fluorine flames of two mixture ratios over a wide range of steady state sample temperatures. Metallographic analysis of some samples were performed to determine the degree of internal interaction for both fluorine and hydrogen rich flame environments. Electron microprobe and x-ray diffraction techniques were used to identify reaction products in the microstructure of certain samples. Author (NSA)

N68-14918# Los Angeles State Coll., Calif. Dept. of Chemistry.
BORON-11 DECOUPLING STUDIES ON THE PROTON NMR OF $C_2B_4H_8$
Thomas Onak Dec. 1967 5 p refs
(Contract Nonr-3364(00))
(TR-15; AD-662680)

With boron-11 decoupling experiments carried out at 19.2 Mc it is possible to selectively irradiate the high and low field proton nmr quartets. When the high field quartet is collapsed the rest of the spectrum remains unchanged. In striking contrast, collapse of the low field quartet is accompanied by a markedly sharpened bridge hydrogen region. Such observations are consistent only with the original Ht-B1 (no bridge hydrogens) assignment to the high field quartet. Author (TAB)

N68-14934# National Bureau of Standards, Washington, D. C.
SELECTED VALUES OF ELECTRIC DIPOLE MOMENTS FOR MOLECULES IN THE GAS PHASE
Ralph D. Nelson, Jr. (Middlebury Coll.), David R. Lide, Jr., and Arthur A. Maryott 1 Sep. 1967 54 p refs
(NSRDS-NBS-10) GPO: HC $0.40; CFSTI: MF $0.65

This table revises, brings up to date, and extends the coverage on numerical values for dipole moments. A recommended value with an estimate of accuracy is presented for more than five hundred organic and inorganic compounds. Extensive comments are given on the definition of dipole moment and principal methods of dipole moment measurement, as well as an exposition of the criteria employed in selecting the tabulated data. Author

N68-14936# Bureau of Mines, Berkeley, Calif.
HIGH TEMPERATURE HEAT CONTENTS AND ENTROPIES OF DEHYDRATED ANALCITE, KALIOPHILITE, AND LEUCITE
Louis B. Pankratz Feb. 1968 13 p refs
(BM-RI-7073)

Measurements were made above 298.15° K for dehydrated analcite ($NaAlSi_2O_6$) to 1,000° K, kaliophilite ($KAlSiO_4$) to 1,800° K, and leucite ($KAlSi_2O_6$) to 1,800° K. Heat content and entropy

increments were tabulated, and the heat content data are given in equation form. A first order transition was noted for kaliophilite near 810° K with a heat absorption of 160 cal/mole. Leucite had a second order transition which became complete near 955° K. In this transition a crystal change occurred from tetragonal (low-temperature form) to cubic (high-temperature form). Author

07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-13948* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
ANALYSIS AND MINIMIZATION OF MESSAGE ERROR IN PCM TELEMETRY SYSTEMS
P. A. Wintz and A. J. Kurtenbach Dec. 1967 178 p refs
(Grant NsG-553)
(NASA-CR-91666; TR-EE67-19; PRF-5120) CFSTI: $3.00 CSCL 09D

To evaluate the effect of errors on the reconstructed waveform, the mean-integral-square error criterion is used. The error between sample functions of stationary, second order processes and their facsimiles are minimized. The approach used is to tie together the existing specialized results adding necessary details and extensions where necessary in order to complete an analysis and optimization of the entire system. It is analytically shown that the optimum quantizer is a function of the channel transition matrix and the necessary conditions are given for a quantizer structure to be optimum. Suboptimum quantizer structures are also presented. Detailed numerical results are presented for an example of the stationary Gaussian Markov source. A data compression scheme using Hotelling's method of principal components on time samples is evaluated by computer simulation. A conventional PCM telemetry system which utilizes time samples, no data compression, and includes a noisy channel is simulated. Author

N68-13997# Massachusetts Inst. of Tech., Cambridge.
ON THE GENERATION OF BARKER CODES
H. Hauck Paris ESRO Sep. 1967 61 p refs Sponsored by ESRO
(ESRO-TN-7) CFSTI: HC $3.00/MF $0.65

Barker codes are binary sequences with very good correlation properties and are used as synchronization patterns for digital communications, or as modulation patterns in ranging systems or as quasi-orthogonal codes. There are several possibilities for generating Barker codes, but the actual implementation of the generators depends on the additional qualities the generated sequences should have. Several properties are discussed and subsequently applied to two basic implementation methods: the first uses a feedback shift-register, and the other uses a binary cascaded counter. Several ways of obtaining an 11-bit Barker code generator from each of the two methods are shown and compared with each other in terms of logic complexity. It is apparent that for all demanded properties, the implementation with a binary counter is superior to all other methods. Author (ESRO)

N68-14025*# Stanford Research Inst., Menlo Park, Calif.
RESONANCES IN THE DRIVING-POINT IMPEDANCE OF AN ELECTRIC DIPOLE IN THE IONOSPHERE
W. E. Blair Mar. 1967 33 p refs Prepared for Stanford Univ., Calif.
(Contract NAS5-9309; SRI Proj.-6045)
(NASA-CR-91620; TR-1) CFSTI: HC $3.00/MF $0.65 CSCL 20N

The resonances in the driving-point impedance of a center-fed cylindrical electric dipole imbedded in the ionosphere are analyzed. The ionospheric model is a lossy, anisotropic, homogeneous neutral plasma containing various ionic constituents. It is found that there are zeros in the reactance at the upper and lower hybrid frequencies and poles at the electron and ion gyrofrequencies. These critical frequencies are independent of antenna length and orientation (parallel or perpendicular to the earth's magnetic field) to the first-order approximation. It is shown that pole-zero frequencies could be used to determine the earth's magnetic field strength, electron density, and ion masses and densities at any point in the ionosphere at which the impedance was measured. Author

N68-14101 Joint Publications Research Service, Washington, D. C.
OBJECTIVE RECOGNITION OF SPEECH SOUNDS
Ye. N. Myasnikova 9 Jan. 1968 130 p refs Transl. into ENGLISH of the book "Obyektivnoye Raspoznavaniye Zvukov Rechi" Leningrad, Energiya Publishing House, 1967
(JPRS-43926) CFSTI: $3.00

The recent achievements in the field of automatic speech recognition are reviewed. The acoustic features of speech sounds and of those characteristics which might serve in the objective recognition of these sounds are examined. The fundamentals of the physical theory of speech sounds and the methods of objective recognition of those sounds are discussed, and the results achieved with these methods are described. The elements of the theory of phonetic operators and of algorithms are also given. Principal attention is paid to the recognition of phonemes. Computer recognition and the technical applications of objective recognition in automatic control are also covered. Author

N68-14165# Entwicklungsring Nord, Bremen (West Germany).
COMPUTATIONS ON ATTENUATION AND PHASE SHIFT OF ELECTROMAGNETIC WAVES IN THE EXHAUST GAS JET OF THE ELDO—A THIRD STAGE
R. Findeisen Paris ELDO 20 May 1965 59 p refs Prepared for ELDO
(ERNO-AB-RTT-1/65/65; TB-3/64; TB-RTT-1/64/65; TB-RTT-1/5/65) CFSTI: HC $3.00/MF $0.65

English version of a partial series of reports dealing with perturbations of radio links of the third stage of ELDO A launch vehicle. Due to the great height and general favorable situation of transmitting and receiving the lowering and phase shift of the radio signal are related only to the shock waves and free jet. The physical principle of interaction between electromagnetic waves and plasma with no magnetic field is dealt with. The temperature conditioned electron density is used for computing the temperature conditioned damping of the transmission jet. The integration is given of the local damping for the total travel of the transmitting jet through the exhaust gas flow of ELDO-A 3rd stage. The main finding is that significant damping should be expected only in the case of 300 km/Woomera. The computation represents an overestimate. ESRO

N68-14234# Royal Aircraft Establishment, Farnborough (England).
ACTIVE AERIALS [AKTIVE ANTENNEN]
H. Meinke Aug. 1967 25 p refs Transl. into ENGLISH from Nachr. Tech. Z. (Brunswick), v. 19, no. 12, 1966 p 697–706
(RAE-TR-1242) CFSTI: HC $3.00/MF $0.65

Active aerials comprise active circuit elements in the form of amplifiers, frequency changers, negative impedances, or switches. These are successfully used for miniaturizing aerials, increasing the bandwidth, shaping the radiation pattern and continuous control of the properties of the aerial by means of dc voltages. Certain transistor arrangements have particularly good prospects. Author

N68-14275*# ADCOM, Inc., Cambridge, Mass.
SNR BEHAVIOR OF COHERENT PHASE DEMODULATORS. RADIO COMMUNICATIONS STUDY ON NOISE THRESHOLD REDUCTION Final Report
Ahmad F. Ghais and Richard H. Wachsman 30 Sep. 1965 89 p refs
(Contract NAS5-9742)
(NASA-CR-80890; G-3) CFSTI: HC $3.00/MF $0.65 CSCL 17B

An analysis of the signal-to-noise ratio at the outputs of three types of coherent phase detectors is performed for the case of sinusoidal phase modulation at various values of phase deviation and a perfectly coherent reference. The phase detectors studied are the conventional multiplier, the sinusoidal phase detector preceded by a limiter, and the cross-over detector. The output noise power is evaluated both in the absence and in the presence of modulation. The results are presented in the form of input–output SNR curves. In the case of noise measured in the absence of modulation, good agreement between theoretical and experimental results is achieved. The output noise measured in the presence of modulation is found to include modulation distortion components and modulation/noise interaction components. A threshold effect is found to occur for the sinusoidal phase detector preceded by a limiter and the cross-over detector, but not for the conventional multiplier. The SNR degradation below threshold is not as catastrophic as that for wideband FM. Author

N68-14389# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
ON THE DIRECTIVITY OF SETS OF ELECTROMAGNETIC RADIATION SOURCES
Werner W. Gerbes Mar. 1967 22 p *Its* Phys. Sci. Res. Papers No. 316
(AFCRL-67-0152; AD-662601)

An investigation was made to find general properties of sets of uniform, isotropic radiation sources in regard to directivity with the intention of simplifying the calculation of the directivity of such sets and finding rules for the construction of optimal configurations in regard to directivity. The general solution that forms the base of the investigation is specialized for the cases where all dipoles lie in a plane and where all lie on a straight line. Author (TAB)

N68-14378# Naval Research Lab., Washington, D. C.
AMBIGUITY RESOLUTION IN THE SPASUR RADIO INTERFEROMETER DIRECTION FINDING SYSTEM
Frank A. Polkinghorn, Jr. and Herbert Farnham 12 Oct. 1967 54 p *ref*
(NRL-6603; AD-662655)

A number of methods for ambiguity resolution for use in the Spasur radio interferometer direction-finding system were derived and were studied using both Monte Carlo and operational data. Implementations of the methods in both hardware and software were analyzed. The conclusion was drawn that the optimum resolution results can be obtained only by the joint optimization of the antenna configuration and the resolution process to form an optimum processing system. Author (TAB)

N68-14444# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
EFFECT OF BRIEFING AND VELOCITY ON THE IDENTIFICATION OF TARGETS FROM SIDE LOOKING RADAR IMAGERY Final Report, Jan.–Jun. 1965
Don F. McKechnie Jan. 1967 47 p refs
(AMRL-TR-66-149; AD-662612)

Thirty-six Air Force radar navigators were asked to find airfields and dams on side-looking radar imagery dynamically displayed at a scale of 1:166,000. During simulated flights, at three aircraft velocities, the subjects were given three levels of information about the targets and their location. As the amount and specificity of target information increased, from minimum to maximum, the number of objects reported as targets decreased 26%, from an average of 9.1 to 6.7 per trial. In spite of this decrease in the total number of objects called targets, the proportion of real targets (seven per trial) that were correctly identified increased 37%, from 43% at the lowest briefing level to 80% at the highest briefing level. At the same time the proportion of identifications that were erroneous (i.e., false positives) decreased 50%, from 67% to 17%. As simulated velocity increased from 600 to 3000 knots the number of objects reported as targets decreased 35%, from an average of 8.8 to 6.3 per trial. With this increase in velocity the proportion of the real targets that were correctly identified decreased slightly, from 66% to 58%. However, compensating for this, the proportion of identifications that were erroneous also decreased--from 48% to 37%. These findings suggest that (a) increased target information is an effective way of enhancing operator performance in a reconnaissance/strike system, and (b) aircraft velocity does not necessarily degrade overall performance. Author (TAB)

N68-14503# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
STUDIES OF MICROWAVE TRANSMISSION THROUGH A HYPERSONIC AIR PLASMA Final Report
D. W. Boyer, G. P. Bein, and S. N. Andre Jun. 1967 115 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SC-CR-67-2710) CFSTI: HC $3.00/MF $0.65

Microwave transmission through a hypervelocity plasma generated about a blunt 20° wedge from an open-ended waveguide on the wedge surface was analyzed. The experiments comprised the measurement of signal attenuation at selected locations in the antenna/model far field, antenna reflection coefficient (magnitude only), and coupling between two adjacent antennas on the model at frequencies of 1.7, 2.6, and 4.0 GHz. Author (NSA)

N68-14555# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Corps of Engineers.
INVESTIGATION OF DYNAMIC BEHAVIOR OF THE NAVY X-BAND ANTENNA AT WALDORF, MARYLAND Final Report
Jack Fowler and Roy E. Leach Oct. 1967 43 p refs Misc. Paper No. 4-937
(AD-662062)

The study was conducted to determine the motion of the structure and foundation of the Navy X-band antenna, at Waldorf, Maryland, during antenna operation. Tests were run to determine the magnitude and direction of displacement, natural frequencies, phase of movement, and attenuation characteristics of the structure and foundation, and the acceleration, velocity, and deceleration of the antenna assembly. Velocity-type transducers were positioned on the antenna tower to measure displacements in the vertical, radial, and transverse planes. Natural frequencies observed for the rocking and torsional modes of motion were from 5.0 to 9.2 cps and 6.1 to 11.0 cps, respectively. The maximum rotation observed near the top of the tower in the torsional mode was 28.6 microradians, whereas at ground level the maximum motion observed was 1.84 microradians. The maximum rotation observed during the rocking mode was 5.50 microradians at the top of the tower and 2.36 microradians at ground level. There was practically no phase shift between transducer locations. Attenuation measurements indicated damping ratios were 0.122 at the top of the structure and 0.065 at ground level during rocking operation and 0.065 at the top during torsional operation. The predicted frequencies and displacements, computed in accordance with the procedures described in EC 1110-345-310, for the torsional mode for the foundation were in very close agreement with the prototype measurements. The prototype measurements for the foundation during the rocking mode were about one-half the values predicted. Author (TAB)

N68-14823# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.

HIGH-GAIN UHF BACKFIRE ANTENNA FOR COMMUNICATIONS, TELEMETRY, AND RADIO ASTRONOMY

H. W. Ehrenspeck Oct. 1967 18 p refs *Its* Instrumentation Papers No. 129

(AFCRL-67-0568; AD-662582)

The backfire antenna described combines the structural advantages of a single endfire with the high gain of a reflector antenna. With its principal application in the gain range between 15 and 30 db where ordinary endfire antennas become impractically long and paraboloidal antennas too expensive, it should prove to be especially advantageous for telemetry and radio astronomy applications in the 100- to 2000-MHz frequency range. The high gain of the backfire is based on the high-amplitude standing-wave field distribution formed between two planar reflectors. The space between the reflectors acts like an open resonating cavity that in basic configuration and function resembles a fabrey-perot laser cavity. An s-band model of a 4.0-wavelength backfire produces a gain of 23.5 db at its optimum frequency, which corresponds to the gain of an equal-size paraboloidal antenna of 60% efficiency. Patterns show a very low side- and backlobe level over a frequency range of 1.25 to 1. Design information for these backfire antennas is given. Compared with an optimized equal-length Yagi, the backfire antenna produces an increase in gain of more than 8 db. To achieve a gain of this magnitude with an ordinary array, one of two recently built antennas for satellite applications uses 16 Yagis, each 2.0 wavelength long, to produce a gain of 22.4 db, and another uses 36 cavity-backed slots to produce 21.2 the single-element backfire antenna, whose 23.5 db gain is achieved through a simple structural design that does not depend on the complicated feed systems that are necessary components in multielement arrays. TAB

N68-14832# Human Factors Research, Inc., Santa Barbara, Calif.

STUDIES WITH NOVEL SONAR DISPLAYS

C. H. Baker and James W. Fundingsland Nov. 1967 27 p refs

(Contract Nonr-4120(00))

(TR-750-9; AD-662405)

Using a general purpose sonar/radar simulator target detection performance was compared for two sonar displays. One display was a conventional sonar PPI display. The other display, termed a wedge display, encouraged a different pattern of visual search. It was hypothesized that the wedge display would result in superior detection performance. Five experiments were conducted--a study of target visibility thresholds, two studies of target detection performance and two studies of detection performance in a vigilance setting. The wedge display was shown to result in superior detection performance. Author (TAB)

N68-14843*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CENTRAL DATA SYSTEM CONCEPTS FOR SPACECRAFT DATA MANAGEMENT

Richard O. Fimmel, Alexander Egger (TRW Systems, Redondo Beach, Calif.), and Louis M. Bello (TRW Systems, Redondo Beach, Calif.) 4 Oct. 1967 19 p refs Presented at the 3d Ann. Intern. Telemetering Conf., Washington, D. C., 2–4 Oct. 1967

(NASA-TM-X-60801) CFSTI: HC $3.00/MF $0.65 CSCL 09F

This paper discusses the design concepts of a central data system (CDS) for more efficient, flexible data management and its application in an advanced deep space solar probe. The design features high data sampling rates, programmable data processing, bulk data storage capability (for data sampled during periods of noncommunication), and standard experiment package/CDS interfaces. The basic system concept is based upon sampling each data point at a high rate in a fixed sequence and allowing a central processor to select, process, and format sampled data into a highly efficient format for transmission. The CDS is programmable so that data formatting and processing may be reprogrammed via the command link to optimize data transmission for unexpected conditions. Preliminary design efforts have indicated that a CDS to process data from seven particle and fields experiments can be designed, using present state-of-the-art components, to weigh 16.5 lb and consume 5.4 watts from the DC/DC converter. Author

N68-14758 Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA: SCIENCE AND TECHNOLOGY, NO. 399: METHODS OF FINDING PULSE COMPRESSION SIGNALS OF NONCYCLIC BINARY CODES

Liu Ch'en-hau 19 Jan. 1968 18 p refs Transl. into ENGLISH from Chung-kuo K'o-hsueh Chi-shu Ta-hsueh Hsueh-pao (Peking), v. 1, no. 1, Feb. 1965 p 123–133

(JPRS-44088) CFSTI: $3.00

Methods of compiling binary noncyclic codes in regard to pulse radar requirements and autocorrelation function requirements are described. The code compilation methods are based on the following procedures: solving the correlation function equation; increasing code elements; changing code elements; combining codes; and finding symmetrical codes. N.E.N.

N68-14783 Ministry of Technology, Orpington (England). Technical Information and Library Services.

THE RAISTING GROUND RADIO STATION FOR COMMUNICATIONS VIA LONG-RANGE SATELLITES [DIE ERDEFUNKSTELLE RAISTING FUR DEN NACHRICHTEN-VERKEHR UBER FERNMELDESTALLITEN]

M. Schonfeld Nov. 1967 26 p refs Transl. into ENGLISH from Luftfahrttech.-Raumfahrttech. (W. Germany), v. 11, no. 9, Sep. 1965 p 230–237

(TIL/T-5750) CFSTI: $3.00

The installation and characteristics of the Raisting station are described in detail, including noise temperature, aerial gain, wide and narrow band installations. Numerical examples are given to illustrate the performance and comparison is made with similar stations in other countries. Author

N68-14792*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SPACE PROGRAMS SUMMARY NO. 37-48, VOLUME 2, FOR THE PERIOD SEPTEMBER 1 TO OCTOBER 31, 1967. THE DEEP SPACE NETWORK

30 Nov. 1967 186 p refs

(Contract NAS7-100)

(NASA-CR-91814; JPL-SPS-37-20, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Continuing researches are reported for the period September 1 to October 31, 1967. The areas of investigation include the following: tracking and navigational accuracy analysis; communications engineering and development; high-rate telemetry project; antenna engineering; and facility engineering and operations. N.E.N.

N68-14819*# ADCOM, Inc., Cambridge, Mass.

RADIO COMMUNICATIONS STUDY ON NOISE THRESHOLD REDUCTION. TASK 3: OSCILLATOR STABILITY IN A TRACKING SYSTEM Final Report

Ahmad F. Ghais 28 Aug. 1965 28 p refs

(Contract NAS5-9742)

(NASA-CR-80891) CFSTI: HC $3.00/MF $0.65 CSCL 17I

The effects of oscillator jitter on the performance of a tracking system are studied. It is found that the power spectrum of the frequency (or phase) fluctuations is a meaningful and useful characterization of oscillator jitter. The mean-square error introduced by an oscillator in the measurement of range or range-rate is related to this spectrum. Simple relationships result, enabling the identification of those parts of the jitter spectrum which represent

short-term and long-term instabilities. The dividing line may be drawn roughly at a frequency $1/\tau$, where τ is the round-trip propagation time. Thus, long and short term instabilities are distinguishable only in the context of a given application. The contributions of the various jitter sources to the overall range-rate error are evaluated. It is concluded that oscillator specifications for future systems should be made on the basis of jitter spectra, and accurate measurement techniques should be developed for evaluation of oscillator stability. Author

N68-14853# California Inst. of Tech., Pasadena.
SELECTED PROBLEMS IN THE THEORY OF ELECTROMAGNETIC RADIATION Final Review Report
Charles H. Papas Sep. 1967 16 p refs
(Contract AF 49(638)-1266)
(AFOSR-67-2352; AD-662017)

The report briefly summarizes the effort directed towards understanding of electromagnetic radiation propagation and scattering in inhomogeneous media. Models are postulated for antenna radiation through inhomogeneous dispersive media, weakly ionized gases, and gyroelectric plasmas. Analytical expressions are derived to describe the interactions. Effort was also directed toward defining the scattering ability of these same media. A new theory for calculating antenna radiated power was formulated which eliminated the discontinuities obtained by conventional analysis. A rigorous solution was derived for the problem of shielding against high-intensity electromagnetic bursts (EMP). At present however, the analytical description is quite idealized. The method of invariant imbedding was used to analytically describe the scattering capability of a jet stream. The description is very powerful in that the reflection coefficient can be found without knowing the wave functions within the stream. The present work is directed toward obtaining an understanding of the interactions between electromagnetic radiation and moving inhomogeneous media. Author (TAB)

N68-14994# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A MULTICHANNEL AIRBORNE CODING CONVERTER [MNOGOKANAL'NYY BORTOVOY KODIRUYUSHCHIY PREOBRAZOVATEL]
N. K. Vinnichenko and G. N. Shur 24 Jul. 1967 17 p refs
Transl. into ENGLISH from Tsentr. Aerol. Observ. Tr. (USSR), no. 63, 1965 p 98–103
(FTD-HT-67-245; AD-662207)

The paper describes an eight-channel aircraft coding converter designed for conversion of signals from transducers sensing pulsation meteorological parameters to a form suitable for subsequent magnetic recording. Author (TAB)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-13957# Oak Ridge National Lab., Tenn.
MATHEMATICS AND COMPUTER PROGRAMS
In its Neutron Phys. Div. Aug. 1967 p 89–93 refs (See N68-13952 05-24)

Programs and codes used for calculations in shielding investigations, neutron cross section determinations, and related studies are described. Problem areas are identified, and modifications of the programs are indicated. Time-sharing computer services are also mentioned. N.E.N.

N68-13978# Systems Development Corp., Santa Monica, Calif.
TIME-SHARING VERSUS BATCH PROCESSING: THE EXPERIMENTAL EVIDENCE
Harold Sackman 10 Oct. 1967 43 p refs
SP-2975; AD-661665)

The continuing controversy over the relative merits of time-sharing versus batch processing has taken a new and significant turn from prediscipliinary speculation to applied scientific experimentation. Within the last two years, five experimental studies have appeared in the literature, each comparing some form of online and offline data processing with respect to man-machine measures of system performance. These five pioneering studies comprise the first substantive data base for comparing and evaluating experimental methodology and findings bearing on the growing and changing competition between time-sharing and batch processing systems. This paper provides a critical review of these five experiments, summarized findings, problems and pitfalls, and offers recommendations for future experimental work. Author (TAB)

N68-14028# System Development Corp., Santa Monica, Calif.
PRE-AFL
Seymour Ginsburg, Sheila Greibach (Harvard Univ., Cambridge, Mass.), and John Hopcroft (Cornell Univ., Ithaca, N. Y.) 14 Aug. 1967 24 p refs
(Contract F19628-67-C-0008; Grant AF-AFOSR-1203-67)
TM-738/037/00; SR-10; AFCRL-67-0538; AD-661969)

A pre-AFL is a family of sets of words closed under certain basic operations. Each pre-AFL contains all regular sets and becomes an abstract family of languages when closed under length-increasing homomorphism. A number of situations in automata and language theory giving rise to pre-AFL are presented. Author (TAB)

N68-14034 National Bureau of Standards, Washington, D. C.
THE SOLID SYSTEM. 2. NUMERIC COMPRESSION. THE SOLID SYSTEM. 3. ALPHANUMERIC COMPRESSION
P. A. D. de Maine, K. Kloss, and B. A. Marron 15 Aug. 1967 45 p refs
(NBS-TN-413) GPO: $0.30

CONTENTS:

1. THE SOLID SYSTEM. 2. NUMERIC COMPRESSION P. A. D. de Maine, K. Kloss, and B. A. Marron p 1–25 refs (See N68-14035 05-08)

2. THE SOLID SYSTEM. 3. ALPHANUMERIC COMPRESSION P. A. D. de Maine, B. A. Marron, and K. Kloss p 27–42 (See N68-14036 05-08)

N68-14035 National Bureau of Standards, Washington, D. C.
THE SOLID SYSTEM. 2. NUMERIC COMPRESSION
P. A. D. de Maine, K. Kloss, and B. A. Marron *In its* The Solid System. 2. Numeric Compression. The Solid System. 3. Alphanumeric Compression 15 Aug. 1967 p 1–25 refs (See N68-14034 05-08)

The general NUMERIC COMPRESSOR (NUPAK) Algorithm is described for automatically compressing (encoding) or decoding compressed numerical information, which may of course have come from graphical information. The amount of compression achieved is determined by the "lowest limit of significance," the range, and the sequential patterns of the data to be stored. The encoded information can be stored in memory or on external storage devices in a small fraction of the space normally required, and can be expanded (decoded) item-by-item whenever needed by the system. Author

N68-14036 National Bureau of Standards, Washington, D. C.
THE SOLID SYSTEM. 3. ALPHANUMERIC COMPRESSION
P. A. D. de Maine, B. A. Marron, and K. Kloss *In its* The Solid System. 2. Numeric Compression. The Solid System. 3. Alphanumeric Compression 15 Aug. 1967 p 27–42 (See N68-14034 05-08)

An algorithm for compressing alphanumeric information is described. Unlike other methods which depend upon frequency of occurrence of words in a particular class of publications, this scheme is language and content independent since the information for compression is obtained from the text itself. The compressed bit stream is preceded by sufficient information for automatic reconstruction of the original bit stream whenever the system requires it. Even with this additional information required for expansion, compression rates approaching 40% have been achieved. Because this alphanumeric compressor (ANPAK) is fully automatic and self-organizing, it can operate on information which has already compressed via the numeric compressor (NUPAK). Author

N68-14074# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.
AN 880 KILOBIT/SEC DATA TRANSMISSION SYSTEM FOR COMPUTER-TO-COMPUTER COMMUNICATION
J. S. Austin, R. C. M. Barnes, and P. J. B. Fergus Jul. 1967 15 p
(AERE-R-5529) HMSO: 2s 6d

A data transmission system is being developed for communication between the A.E.R.E. central computer complex and remote computers serving experiments. The minimum data transfer rate is 88 kilobytes/sec. for 8-bit bytes, or 63 kilobytes/sec for 12-bit bytes. Each data link operates over two pairs of wires in the multi-pair telephone cables which are being installed for remote Teletype terminals of the central computer. Author

N68-14360*# Massachusetts Inst. of Tech. Cambridge. Dept. of Mathematics.
SYMBOLIC INTEGRATION
Joel Moses (Ph.D. Thesis, Sep. 1967) Dec. 1967 271 p refs
(Grant NsG-496; Contracts Nonr-4102(01); DP--28-043-AMC-02536(E); Grant NSF GP-2495; Proj. MAC)
(NASA-CR-91824; MAC-TR-47; AD-662666) CFSTI: HC $3.00/MF $0.65 CSCL 09B

SIN and SOLDIER are heuristic programs written in LISP which solve symbolic integration problems. SIN (Symbolic Integrator) solves indefinite integration problems at the difficulty approaching those in the larger integral tables. SIN contains several more methods than are used in the previous symbolic integration program SAINT, and solves most of the problems attempted by SAINT in less than one second. SOLDIER (SOLution of Ordinary Differential Equations Routine) solves first-order, first-degree, ordinary differential equations at the level of a good college sophomore and at an average of about five seconds per problem attempted. The differences in philosophy and operation between SAINT and SIN are described, and suggestions are made for extending this work. Author (TAB)

N68-14364# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.
ASSOCIATIVE TECHNIQUES FOR CONTROL FUNCTIONS IN A MULTI-PROCESSOR SIMULATION INVESTIGATION Final Technical Report, Jan.–Aug. 1967
R. Gonzalez, D. C. Gunderson, and J. A. Timmons Griffiss AFB, N. Y. RADC Nov. 1967 147 p ref
(Contract F30602-67-C-0175)
(RADC-TR-67-500; Rept.-12059-FRI; AD-662361)

A simulator of a multiprocessor with associative control was developed for purposes of evaluating and studying the use of associative memories for executive control functions in multiprocessors. A job generator was also developed to provide a source of jobs to use in the simulation studies. Some preliminary results were obtained in terms of system efficiency and requirements on the associative memories. Author (TAB)

N68-14412# Princeton-Pennsylvania Accelerator, Princeton, N. J.
BUBBLE CHAMBER GEOMETRY MEASUREMENTS ON-LINE WITH A PDP-5 TO IBM 360-50 CONNECTION
J. Ball, M. Bazin, J. Benoit, and R. C. Davis, Jr. 7 Sep. 1967 8 p refs
(Contract AT(30-1)-2137)
(PPAD-629C) CFSTI: HC $3.00/MF $0.65

Bubble chamber measurements have been carried out at the Princeton–Pennsylvania Accelerator on-line to a PDP-5 computer. The PDP-5 computer produces a tape which is directly readable by the THRESH geometry program for off-line analysis. The direct connection of the PDP-5 control computer to an IBM 360-50 in which the THRESH program resides is described. NSA

N68-14471# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIENCE IN OPERATION AND DEVELOPMENT OF THE M-20 ELECTRONIC DIGITAL COMPUTER [OPYT EKSPLUATATSII I USOVERSHENSTVOVANIYE EKTRONNOY TSIFROVOY VYCHISLITEL'NOY MASHINY M-20]
M. T. Kobzar' and A. M. Smagliy 27 Jun. 1967 35 p refs Transl. into ENGLISH from the Publ. "Tsifrovaya Vychislitel'naya Tekhnika i Programmirovaniye" Moscow, Izd. Sov. Radio, no. 1, 1966 p 87–102
(Contract AF 33(657)-16408)
(FTD-HT-67-247; AD-662588)

The paper discusses the experience obtained in operation and the methodology of preventive maintenance for the M-20 electronic computer (ETsVM) in the course of five years, describes the rational organization and development of the preventive maintenance schedule whose introduction expands the logical capabilities of the computers and improves their operational reliability. Author (TAB)

N68-14474# Information Research Associates, Inc., Lexington, Mass.
DIGITAL SIMULATION OF THE WIENER CANONICAL EXPANSION
Donald B. Brick, Larry W. Petri, and Ernest G. Henrichon 22 Aug. 1967 88 p refs Revised
(Contracts AF 49(638)-1631; AF 33(615)-3758)
(TR-13; Rept.-102:15; Rept.-107:11; AD-662014)

This effort is a substantial part of an overall program whose aim is to rigorize, continue, extend, and apply recent research results by investigating the application of Wiener Canonical representations through the synthesis of decision structures and bionic systems. The immediate goal of the total program was to define the degree of usefulness and the limits of applicability of these techniques in actual systems. A combined theoretical and computer analysis approach was utilized. The results of this effort are very encouraging; computer simulations have proved the practicality of realizing Hermite-Laguerre processors of good accuracy at moderate cost, using the Wiener process as a test case. Further research aimed at applying the Wiener Canonical likelihood function ratio concept to other processes was recommended. Author (TAB)

N68-14556# System Development Corp., Santa Monica, Calif.
INDEPENDENCE OF AFL OPERATIONS
Sheila Greibach and John Hopcroft 12 Jul. 1967 14 p refs
(Contract F19628-67-C-0008; Grant AF-AFOSR-1203-67)
(TM-738/034/00; SR-7; AFCRL-67-0495; AD-662602)

The axiomatic properties used to define abstract families of languages are considered. The properties are shown not to be independent. All independent subsets that imply the remaining properties are found. Finally alternative operations are considered. Author (TAB)

N68-14625# Naval Weapons Lab., Dahlgren, Va.
CALLIGRAPHY FOR COMPUTERS
A. V. Hershey 1 Aug. 1967 241 p
(NWL-TR-2101; AD-662398)

Consideration is given to the possibility of providing a computer and a cathode ray printer with an unlimited repertory of characters. Digitalizations are presented for mathematic, cartographic, and calligraphic characters. The repertory is available to any computer through Fortran IV programming. The latest cathode ray printers are almost adequate for the preparation of mathematical reports. Some progress has been made toward development of a mnemonic code for the recording of a mathematical text on tape. Author (TAB)

N68-14702# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
AN N^2-RECOGNIZER FOR CONTEXT FREE GRAMMARS
Jay Earley Sep. 1967 19 p refs
(Contract ARPA SD-146)
(AFOSR-67-2714; AD-662633)

An algorithm is described which is a recognizer for any context-free grammar. It is shown that the bound on the time the algorithm takes to recognize any string with respect to an unambiguous grammar is proportional to n2, where n is the length of the string, that a bound on the time for recognizing any string is proportional to n3, and that a bound on the space required is proportional to n2. Author (TAB)

N68-14753 European Organization for Nuclear Research, Geneva (Switzerland). Health Physics Group.
FORTRAN PROGRAMMES FOR THE TREATMENT OF PERSONNEL MONITORING DATA
J. Dutrannois and K. S. Koelbig 29 Sep. 1967 46 p refs
(CERN-67-28)

Computer programs for interpreting radiation exposure data on film badges worn by personnel are described. The programs are written in Fortran. The main programs, WEEKLY and MONTHLY; the subroutines DOSES, IDORND, PERIOD, MESAGE, and DATEZB; and the input and output data for the programs, are described. Statistical programs WSTATI and MSTATI; functions MAXMUM, MORMAX, and ISUM; subroutine EXCHZL; and input and output data for WSTATI and MSTATI, are also described. A listing of the program MONTHLY is given. L.S.

N68-14762# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Aachen (West Germany). Institut fuer Theoretische Gasdynamik.
COMPUTING FACILITIES OF DVL. SYSTEMPLANNING AND EXTENSIONS UNTIL JULY 1967 AND RESEARCH PROBLEMS IN 1966 FOR WHICH COMPUTERS HAVE BEEN USED [DATENVERARBEITUNGSANLANGEN DER DVL. PLANUNG UND AUSBAU (STAND: JULI 1967) UND FINSATZ FUER FORSCHUNGSPROBLEME IMJAHRE 1966]
A Kurav Nov. 1967 50 p refs In GERMAN; ENGLISH summary
(DVL-678; DRL-Mitt.-67-20)

The system considerations of new or extended computing facilities are described in the article. The average utilization and the configuration of the facilities in the years 1964, 1965, 1966 and 1967 are shown. In the last part of the article a short survey of research problems of the DVL-Institutes for which the computers have been used is given. Author

N68-14804# Dikewood Corp., Albuquerque, N. Mex.
POLYFIT: A GENERALIZED LEAST SQUARES CURVE-FITTING PROGRAM
D. Angel, R. C. Lindberg, and S. G. Vandevender 31 Aug. 1967 89 p Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SC-CR-67-2715) CFSTI: HC $3.00/MF $0.65

A computer program (POLYFIT) written in FORTRAN for the CDC 3600 for finding the best possible fit for a set of 1000 or less data points is presented. The phrase best possible fit refers to a curve of the form $Y^{PX^m}=a_0+a_1X+a_2X^2+...+a_nX^n$. The order of fit may be in the range $1\leq n\leq 11$; the range of the power of X is $0\leq m\leq 6$; and the range of the power of Y is $1\leq p\leq 3$. NSA

N68-14859# Sandia Corp., Albuquerque, N. Mex.
HEURISTIC FOR COMPUTER-AIDED SYNTHESIS OF MULTIPLE-OUTPUT ALL NAND COMBINATIONAL-LOGIC CIRCUITS
L. W. Maschoff Oct. 1967 26 p refs
(Contract AT(29-1)-789)
(SC-DR-67-693) CFSTI: HC $3.00/MF $0.65

A heuristic for synthesis of multiple-output ALL NAND combinational-logic circuits is discussed. Results of implementing this heuristic on the time-shared SDS 930 and CDC 3800 are included. Some discussion of minimality is also included. Author (NSA)

N68-14970# California Univ., Berkeley.
GO GENIE GRAPHICAL INPUT–OUTPUT SYSTEM
B. W. Lampson 19 May 1967 61 p Revised
(Contract ARPA SD-185)
(R-19; AD-662417)

The document is intended to be a complete description of the Project Genie display hardware and its basic software support. The only system which is not fully documented here is the PDP 5 debugger, ARPAL, which has its own manual (R-14). TAB

N68-14984# California Univ., Livermore. Lawrence Radiation Lab.
PUBLISHABLE GRAPHS BY COMPUTER—A FLEXIBLE, EASY-TO-USE PROGRAM FOR THE CALCOMP PLOTTER
J. R. Terrall 15 Apr. 1967 32 p
(Contract W-7405-ENG-48)
(UCRL-50250) CFSTI: HC $3.00/MF $0.65

This program produces inked graphs from any subroutine that merely defines y as a function of x. It was written in FORTRAN II for the CALCOMP plotter, but it requires no knowledge of the plotting routines. The pen may be stopped at will, by input, for changing the width of lines in order to achieve emphasis and artistry. Labels and titles, punched on input cards, are automatically centered, or started at a particular point. Also, they can be titled by an input number. The program has been found extremely useful, not only in producing publishable graphs, but also in making working drawings for testing various formulas, and for comparing with curves that already exist (in journals, for example). Because of the flexibility in size, a plot can be made to exactly the same scale as an existing drawing and then the two can be compared by making use of the semitransparency of the plotting paper. Author (NSA)

N68-14995# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MN-14 ELECTRONIC NONLINEAR ANALOG COMPUTER
V. B. Ushakov, G. M. Petrov, Ye. P. Basov, N. B. Lakunin, and V. A. Popov 4 May 1967 111 p Transl. into ENGLISH from the book "Elektronnaya Nelineynaya Analogovaya Vychislitel'naya Mashina MN-14" (Moscow), 1965 p 3–69, 108–133, 152–164, and 219–233
(FTD-MT-66-54; AD-662381)

Content of this book is aimed at revealing technical capabilities of computers and prospects for their further improvement. Also, the material of the book acquaints the reader with the correct approach to technical applications of computers. TAB

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-14100# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).
RADIATION DAMAGE OF BIPOLAR TRANSISTORS BY PROTONS (2.5 TO 4.5 MeV) AND BY ELECTRONS (1.5 MeV) [DIE SCHAEDIGUNG VON BIPOLAREN TRANSISTOREN DURCH BESTRAHLUNG MIT PROTONEN IM ENERGIEBEREICH 2,5–4,5 MeV UND ELEKTRONEN DER ENERGIE 1,5 MeV]
A. Spencker, G. Schnell, H.-G. Wagemann, and O. Meinhardt Jul. 1967 35 p refs In GERMAN
(HMI-B-61)

The influence of protons at 2.5 to 4.5 MeV and electrons at 1.5 MeV on bipolar transistors is investigated by means of four types of recombination currents, which exist in the base of a bipolar transistor. These different types are separated by analyzing $I_B = f(U_{EB})$ characteristics. Their influence on current gain is discussed by means of the Webster equation. Theoretical introduction and measuring techniques without and with ionizing radiation are described. The results show that unwanted types of recombination current are generated by irradiation especially for low current injections ($I_B = 10^{-9} - 10^{-6}$A) into the transistor. Semiconductor devices of different origin are compared. Author (NSA)

N68-14202*# Watkins-Johnson Co., Palo Alto, Calif.
THE EFFICIENCY IMPROVEMENT PROGRAM FOR THE WJ-274 TRAVELING WAVE TUBE
Lester A. Roberts [1967] 70 p ref
(Contract NAS1-5923)
(NASA-CR-66522; Rept.-66522) CFSTI: HC $3.00/MF $0.65 CSCL 09A

This report describes the work done on a 20 watt space-type traveling-wave tube. The purpose of the program was to study techniques to further improve its overall efficiency characteristics. The studies resulted in the development of a single helix, PPM focused traveling-wave tube capable of delivering 25 watts of power output at 2.3 GHz at an overall efficiency (including heater) of 42.2 percent. These characteristics are achieved with a saturation gain of 34 dB. Author

N68-14213* Martin Co., Orlando, Fla.
ENGINEERING ANALYSIS AND STUDY ON CRACKED SOLDER JOINTS Final Report
D. F. Diel Apr. 1967 105 p
(Contract NAS8-18738)
(NASA-CR-61422; OR-8813) CFSTI: $3.00 CSCL 09A

The cause of developing cracks in solder joints on the Control Signal Processor (CSP) was investigated. The investigation consisted of two approaches. The first one, an empirical technique, was aimed at circumventing the problem by (1) designing, fabricating, and testing a number of joint designs; (2) analyzing and evaluating the results; and (3) incorporating the information learned into second and third generation solder joints. The second approach was an investigation of the causative mechanisms involved in the development of cracks in solder joints, especially in transistor leads soldered to printed circuit boards. This required analyzing the solder joints tested in the first approach as well as designing and testing separate specimens for investigating specific characteristics. The criterion for a satisfactory solder joint was established as a solder joint that could endure at least 1000 thermal cycles, without developing any surface cracks visible at a 30X magnification. The thermal cycle established for this program was the CSP limits of −55° to +125°C, a complete cycle requiring 45 to 60 minutes. Author

N68-14279* Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
SULFIDE RECTIFIER [SUL'FIDNYY VYPRYAMITEL']
Yu. A. Dunayev and B. V. Kurchatov Washington NASA Jan. 1968 19 p refs Transl. into ENGLISH from Zh. Tekhn. Fiz. (Leningrad), v. 10, no. 22, 1940 p 1857–1870
(Contract NASw-1692)
(NASA-TT-F-11450) CFSTI: $3.00 CSCL 09A

A brief description is given of the design of a sulfide rectifier and its electrotechnical parameters. The rectifier is operated on direct and alternating currents, and the capacitance of the barrier layer is measured. Conclusions as to the normal electron mechanisms of a sulfide rectifier are presented. Author

N68-14325# Army Electronics Labs., Fort Monmouth, N. J. Electronic Parts and Materials Div.
UNLOADED Q OF A CAPACITIVELY LOADED TEM RESONATOR
Elio A. Mariani Oct. 1967 19 p refs
(ECOM-2885; AD-662270)

The report describes some practical techniques for capacitively loading TEM resonators in the UHF frequency range (200 - 1000 MHz). The effect of various loading capacitors (air dielectric, Al2O3, sapphire, and lumped element), as well as the effect of fine-tuning on the unloaded Q, is presented. A design example is included in order to illustrate the use of certain design curves inclosed. Author (TAB)

N68-14451# Cambridge Univ. (England). Cavendish Lab.
THE MEASUREMENT OF SMALL VOLTAGES USING A QUANTUM INTERFERENCE DEVICE
John Clarke *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 11 p refs (See N68-14447 05-23)

Properties of two Josephson tunneling junctions connected in an otherwise superconducting ring are considered, and measurement of small voltages in these weak-link devices is accomplished with a quantum interference device. Possible sources of noise which limit the sensitivity of the voltage measuring device are noted, and efforts to reduce the noise level with a superconducting transformer are reported. A configuration is described that affords the possibility of using a slug as an impedance transformer to increase voltage sensitivity. M.W.R.

N68-14483# Ford Motor Co., Dearborn, Mich. Scientific Lab.
A SUPERCONDUCTING OSCILLATOR-DETECTOR
Arnold H. Silver *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 18 p (See N68-14447 05-23)

Experiments relating to the Josephson effect and the macroscopic quantization of superconductors are discussed, along with an oscillating detector that makes use of some of the experimental findings. Multiply connected configurations that incorporate a weak link or weak contact are considered; and properties of these superconductors are reviewed along with those of configurations that incorporate a finite resistance within their superconducting rings. In all of these radio frequency studies of superconducting point contacts the quantum behavior is dominant. In the oscillating detector there is a loss of power from the oscillator to an external circuit at extremely low power levels; and this loss should be reversible since very small amounts of rf power incident on the Josephson oscillator can be detected in a narrowband, frequency selective manner. Frequency selection is determined by an applied dc voltage adjustable over a very wide range; and the oscillating detector has been subjected to a single scan from dc to 40 kMcps indicating its potential for cryogenic use with very low power and very high sensitivity. M.W.R.

N68-14454# Pennsylvania Univ., Philadelphia. Dept. of Physics.
CURRENT FLUCTUATIONS IN SUPERCONDUCTING TUNNEL JUNCTIONS
D. J. Scalapino *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 19 p Sponsored by ARPA (See N68-14447 05-23)

Based on the high sensitivity and stability exhibited by superconducting devices, fluctuations in Josephson tunnel junctions are discussed. While the results presented are calculated for models appropriate to a junction, some of the conclusions are applicable to other types of weak-link systems. Noise analysis and tunnel resistance are discussed, as is the power spectrum when there is phase coupling across the barrier. Various equations are given for determining voltage power spectrum and fluctuations. M.W.R.

N68-14456# Bell Telephone Labs., Inc., Murray Hill, N. J.
JOSEPHSON EFFECT FAR INFRARED DETECTOR
Sidney Shapiro *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 17 p refs (See N68-14447 05-23)

The use of Josephson junctions at far infrared frequencies that go up to and beyond the superconducting energy gap is reported. Experiments on point contact junctions consider the term Josephson junction to refer to any superconductor-barrier-superconductor system which is capable of passing a zero voltage current. A far infrared spectrometer is shown, along with the detection equipment used to measure the response of Josephson current as a function of frequency. A typical interferogram is shown that is representative of the form of the raw experimental data; and spectral response curves are given for In-In, Nb-Nb, Nb-Ta, Ta-Ta, and Pb–Pb superconducting point contacts. Performance figures achieved for the point-contact Josephson junction detector are frequency response to wavelengths shorter than 300 microns, sensitivity better than 5×10^{-13}W noise equivalent power, and response time better than 10 nanoseconds. M.W.R.

N68-14459# Cutler-Hammer, Inc., Melville, N. Y. Airborne Instrument Lab.
HIGH CIRCUIT Q'S WITH NIOBIUM STANNIDE AT RADIO FREQUENCIES
Kenneth Siegel, R. Domchick, and F. R. Arams *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 10 p refs (See N68-14447 05-23)

Niobium stannide was investigated for use in a simple refrigerated radio frequency preselector to reduce interference in radio communications. Open cycle data are discussed, and results of a vapor deposited coil in a shield made from the diffused niobium tin foil are shown. Data are given for a small closed cycle 10 deg refrigerator, and, as before, the fall-off with temperature is noted for the diffused material. M.W.R.

N68-14461# International Business Machines Corp., Yorktown Heights, N. Y. Watson Research Center.
THE JOSEPHSON JUNCTION AS A SWITCHING DEVICE
Juri Matisoo *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices, Aug. 1967 10 p (See N68-14447 05-23)

A switch or logic element is described that uses the Josephson junction as a two-state device. One state is the zero voltage pair tunneling, the other is quasi-particle tunneling; and a combination of fields and currents in the junction controls transition between states. Characteristics of the Josephson junction as a switching device include transition time of ≤ 1 ns, current transfer times of ≤ 1 ns depending upon circuit characteristics, and circuit gain because the amount of current required for controling the threshold is substantially less than the current flowing through the junction. M.W.R.

N68-14463# Army Electronics Labs., Fort Monmouth, N. J.
MICROWAVE MIXING WITH WEAKLY COUPLED SUPERCONDUCTORS
Gerhart K. Gaule', R. L. Ross, and K. Schwidtal *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 6 p refs (See N68-14447 05-23)

Self-consistent sets of all essential Fourier components have been determined with a digital computer by stepwise inserting improved estimates of the higher Fourier components of the current; and the method used is outlined. Estimates for optimum local oscillator amplitudes and dc bias were obtained, and logarithmic presentations of the Fourier components of the voltage for various bias conditions are included. The third and fifth harmonics are predominant for all bias conditions. A local oscillator and a signal generator, both operating at 10 GHz, is considered; and the local oscillator power needed to produce the step structure is less at 12 GHz than at 9 GHz. The most conspicuous effect of even a very weak signal was to make the step structure disappear. Pressure contacts of oxidized Nb were far more sensitive than crossed vacuum deposited Pb strips; and for both contact-types, diodes with smaller critical currents responded more strongly to radiation. M.W.R.

N68-14465# Illinois Univ., Urbana.
A SUPERCONDUCTING PARAMETRIC AMPLIFIER FOR THE MEASUREMENT OF SMALL dc VOLTAGES
Roger P. Ries and C. B. Satterthwaite *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 7 p ref (See N68-14447 05-23)
(Contract DA-28-043-AMC-00073(E))

A time varying mutual inductance between a set of input and output coils is used to produce parametric amplification of the input signal in a superconducting device for detecting and measuring very small dc voltages in low impedance circuits. Noise analysis indicates that this amplifier is capable of extremely high sensitivities, and equations for determining sensitivity are included. A version of the amplifier built around a small tuning fork with a resonant frequency of about 1200 Hz is shown, and amplifier responses to a 2.4 picovolt square wave signal with a period of 5 min are charted. The smallest experimental amplifier weighed 200 grams and measured 1"×1-3/4"×3-1/2". M.W.R.

N68-14513# Army Edgewood Arsenal, Md. Detection and Warning Lab.
A USEFUL INFRARED SOURCE Technical Report, Jul. 1965–Dec. 1965
Hugh R. Carlon Nov. 1967 29 p
(EATR-4163; AD-662698)

Reliable inconel-sheathed cartridge heaters, rated at hundreds or thousands of watts, have been in use for many years. Miniature

heaters have been manufactured, having axial leads, which when treated with an emissive coating meet or exceed globar emissivities in the infrared. Free-air temperatures approximating 800C have been obtained for power inputs of 10 watts, while temperatures as high as 1150C are possible for short lifetimes (e.g., 10 hours) at power dissipations of 24 watts or more. Sources may be designed to operate from dc or ac power with higher voltages and lower currents depending upon physical size limitations, resulting in simplified power supply problems. Although voltages from 12 to 230 volts are practical for larger units, the sources operated at 1060C from a nominal 1.07 amperes at 18.7 volts dc for a power consumption of 20 watts, variable continuously about this value. The small dimensions of these sources compare favorably to those of a 1/2-watt electronic resistor. The present units are cylindrical, 1 cm long by 4 mm in diameter. The construction of smaller units is possible but difficult under present state-of-the-art limitations. Author (TAB)

N68-14521 Joint Publications Research Service, Washington, D. C.

ELECTRICAL ELEMENTS OF SHIPBOARD RADIOELECTRONIC EQUIPMENT AND COMPUTERS

P. D. Verkhopyatnitskiy 8 Jan. 1968 148 p Transl. into ENGLISH from the book "Elektricheskiye Elementy Sudovykh Radioelektronnykh i Vychislitel'nykh Ustroystv" Leningrad, Sudostr. 1967 p 152–322
(JPRS-43890) CFSTI: $3.00

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N68-14522 Joint Publications Research Service, Washington, D. C.

DELAY LINES WITH LUMPED PARAMETERS (LADDER NETWORK OR NONUNIFORM)

In its Elec. Elem. of Shipboard Radioelectron. Equipment and Computers 8 Jan. 1968 p 1–36 (See N68-14521 05-09)

An overview is given of design criteria for, and applications of, ladder network artificial delay lines. The electrical circuitry and structural form of these units are depicted. Basic electrical parameters of commercially available delay lines are tabulated. The microminiaturization of ladder networks is discussed, and electrical diagrams and modular mountings for microlines are shown. In addition, the parameters of certain high frequency induction chokes are tabulated in terms of the delay line parameters necessary to their selection. E.J.S.

N68-14523 Joint Publications Research Service, Washington, D. C.

DELAY LINES WITH DISTRIBUTED PARAMETERS

In its Elec. Elem. of Shipboard Radioelectron. Equipment and Computers 8 Jan. 1968 37–38 p (See N68-14521 05-09)

A spiral artificial delay line is described in which a long coil serves as the inside conductor, and a copper braid as the outside conductor. This design increases the inductance per unit length and, to a somewhat lesser degree, the capacitance which in turn leads to an increase in the delay time and the wave resistance with a very small cable length. Line input is one end of the coil and the braid lead while output is the other and of the coil and braid. An expression for defining the inductance and capacitance per unit length is presented along with a formula for determining the delay time and wave impedance. Practical aspects of radioelectronic applications of this design are briefly discussed. E.J.S.

N68-14524 Joint Publications Research Service, Washington, D. C.

MULTIELECTRODE MULTIPLE-UNIT TUBES (LOGICAL THYRATRONS)

In its Elec. Elem. of Shipboard Radioelectron. Equipment and Computers 8 Jan. 1968 p 39–43 (See N68-14521 05-09)

The basic electrical parameters of multielectrode thyratrons are tabulated, and a brief discussion is presented on their use in computer design. E.J.S.

N68-14525 Joint Publications Research Service, Washington, D. C.

DECATRONS AND DIGITAL INDICATING LAMPS

In its Elec. Elem. of Shipboard Radioelectron. Equipment and Computers 8 Jan. 1968 p 44–49 (See N68-14521 05-09)

Two types of multielectrode glow discharge tubes used for decade counting and scaling circuits in computational equipment are described. The electronic design and structural form of the decatron is shown, and its basic electrical parameters are tabulated. The digital indicator lamp is discussed and its circuitry is described. E.J.S.

N68-14526 Joint Publications Research Service, Washington, D. C.

MAGNETIC DIELECTRIC (ALSIFERS) AND FERROMAGNETIC OXIDES (OXIFERS)

In its Elec. Elem. of Shipboard Radioelectron. Equipment and Computers 8 Jan. 1968 p 50–62 (See N68-14521 05-09)

Electrical and electromagnetic parameters are given for Alsifer, an alloy of iron with silicon and aluminum, and for various ferromagnetic oxides. A brief discussion on the use of these elements as magnetic cores in computer and radioelectronic equipment is presented. The characteristics of soft magnetic oxide materials and Alsifer cores are tabulated along with the geometric dimensions of Alsifer rings, annular and three-leg oxifer cores, and ferromagnetic oxides in rjng form. E.J.S.

N68-14527 Joint Publications Research Service, Washington, D. C.

POLYCRYSTAL FERRITE MATERIALS WITH A NARROW RESONANCE ABSORPTION LINE AT SUPERHIGH FREQUENCIES

In its Elec. Elem. of Shipboard Radioelectron. Equipment and Computers 8 Jan. 1968 p 63–68 (See N68-14521 05-09)

The material composition of, and manufacturing processes for polycrystal ferrites used in radio equipment are briefly described.

Specific radioelectronic applications mentioned include thyratron systems operating on the principle of superhigh frequency offset of the field in a waveguide, and ferrite devices for low superhigh frequency range operation. Tables are included for the percentage composition of certain ferrites, and the electromagnetic properties of various ferromagnetic oxides. E.J.S.

N68-14528 Joint Publications Research Service, Washington, D. C.
FERRITE CORES WITH A RECTANGULAR HYSTERESIS LOOP
In its Elec. Elem. of Shipboard Radioelectron. Equipment and Computers 8 Jan. 1968 p 69–73 (See N68-14521 05-09)

The manufacturing process used to produce ferrite magnetic cores with a rectangular hysteresis loop, low coercive force, and high transition rates from magnetization of one sign to magnetization of another is briefly described. Recommended operational parameters for logical elements and switching circuit applications are summarized, and the electromagnetic parameters of ferromagnetic oxide devices with a rectangular hysteresis loop are tabulated. E.J.S.

N68-14529 Joint Publications Research Service, Washington, D. C.
STANDARD FUNCTIONAL ASSEMBLIES OF FLAT MODULES
In its Elec. Elem. of Shipboard Radioelectron. Equipment and Computers 8 Jan. 1968 p 74–107 (See N68-14521 05-09)

Summary data are presented on standard, mass produced, flat electronic modules for radioelectronic, computer, and logic circuit applications. The printed circuitry and structural form of the flat plates are depicted. Tables of electromagnetic parameters are included for standard functional assemblies. E.J.S.

N68-14530 Joint Publications Research Service, Washington, D. C.
MICROELEMENTS
In its Elec. Elem. of Shipboard Radioelectron. Equipment and Computers 8 Jan. 1968 p 108–126 (See N68-14521 05-09)

The manufacturing methods for, and applications of, microelements used in microelectronic modules of the multistage type are summarized. Specifically, microminiaturized resistors, capacitors, transistors, diodes, inductance coils, transformers, and resonators are described. Tables of the standardized functional assemblies of the Ural-10V computer, specifications of all-purpose functional modules of the Ural-10V type, and electromagnetic parameters of the various microelements are included. E.J.S.

N68-14531 Joint Publications Research Service, Washington, D. C.
STAGED MICROMODULES
In its Elec. Elem. of Shipboard Radioelectron. Equipment and Computers 8 Jan. 1968 p 127–148 (See N68-14521 05-09)

The electrical and mechanical connections used to assemble microelements into micromodules are described for both polar and nonpolar basings. In addition, micromodules with all purpose basings are discussed. Summary data are presented on the electromagnetic parameters, structural design, and special features of individual micromodules used in radioelectronic and computer circuits. E.J.S.

N68-14532# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany). Abteilung Elektronik.
EFFECTS OF IONIZING ^{60}Co-γ-IRRADIATIONS ON THE PROPERTIES OF MOS-FIELD EFFECT-TRANSISTORS AND MNS-FIELD EFFECT-TRANSISTORS [WIRKUNG IONISIERENDER Co-60-γ-STRAHLUNG AUF MOS- UND MNS-FELD-EFFEKT-TRANSISTOREN]
H.-G. Wagemann Jul. 1967 80 p refs In GERMAN
(HMI-B-62)

An introduction of the physical aspects of and measurement techniques used to determine the effects of gamma radiation on the properties of MOS- and MNS-FET transistors. The electric characteristics of MNS- and MOS-FET's being irradiated by a 3000 Ci ^{60}Co source is discussed by means of curve families, transconductance, gate capacitance, and surface recombination velocity. The change in the electric charge of the insulating layer and at the interface between the semiconductor and insulator is considered. Author (NSA)

N68-14593# Brookhaven National Lab., Upton, N. Y.
FIELD-EFFECT TRANSISTOR NOISE AS A FUNCTION OF TEMPERATURE AND FREQUENCY
V. Radeka [1967] 16 p refs Presented at the Gatlinburg Conf. Semicond. Radiation Detectors and Circuits, Gatlinburg, Tenn., 15–18 May 1967
(BNL-11783; CONF-670520-11) CFSTI: HC $3.00/MF $0.65

Characteristic features of the temperature- and frequency-dependence of the noise spectrum of field-effect transistors are reported. Data for both silicon- and germanium-junction field-effect transistors are presented. NSA

N68-14636*# Hughes Aircraft Co., Torrance, Calif. Electron Dynamics Div.
20 WATT X-BAND TWT DEVELOPMENT Final Report
Sep. 1967 56 p
(Contract NAS1-5905)
(NASA-CR-66525; HAC/EDD-W-2241) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The results of a program to develop a 20 watt, 8.4 to 8.5 GHz traveling-wave tube amplifier suitable for spacecraft applications are summarized. The basic development consisted primarily of extending the state of the art to obtain a required 35% efficiency at X-band. A number of tubes were built using various helix and gun designs to achieve the required results. Helix changes were made to properly center the tube within the desired operating frequency range. Different gun perveances were tried to optimize tube efficiency obtainable by means of depressed collector operation. A total of seventeen tubes were constructed, with the last tube providing the specified power, gain, and efficiency performance. The accompanying power supply is a space type, high efficiency traveling-wave tube power supply. Author

N68-14644*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
AN ADVANCED BRUSHLESS DC TORQUE MOTOR Quarterly Report, 30 Sep.–30 Dec. 1966
W. W. Yates, D. E. Baker, and R. E. Skemfer 30 Dec. 1966 79 p refs
(Contract NAS5-10263)
(NASA-CR-91686; WAED-66-69E; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 09E

This contract covers the development of an advanced version of a brushless d–c torque motor using magnetic sensing of position. The motor will combine the functions of speed control and

commutation, and in addition will provide position and rate information. During the above period, the final detailed design of the motor-controller was completed. Drawings were completed and critical items advance ordered. A final breadboard of the control circuit was completed and operated successfully. No problems are foreseen in making a successful unit. Author

N68-14677# Autonetics, Anaheim, Calif.
RADIATION EFFECTS ON THE THIN-FILM INTEGRATED CIRCUIT ELEMENTS Quarterly Report, Apr. 15–Jul. 14, 1967
V. H. Strahan and A. F. Krueger Nov. 1967 23 p refs
Sponsored by DASA
(Contract DA-28-043-AMC-02431(E))
(Rept.-8; ECOM-02431-3; QR-3; AD-662702)

Efforts were directed toward (1) an experimental determination of the differences in the charge change induced by 600 kV FXR and 2 MV FXR irradiations, 18 MeV LINAC electron, and bremsstrahlung from 18 MeV electrons; (2) the dependence of the radiation induced charge change on substrate thickness for thicknesses near the range of the most energetic Compton electrons, and (3) the effectiveness of a guard ring in limiting the charge change which is neutralized by a circular disc conductor. The experiments performed in each of the above areas are described and the resulting data presented. The presented data shows that (1) charge change is a decreasing function of incident radiation energy, (2) induced charge change decreased with decreasing substrate thickness within the thickness range of 0.0005 inch < or = x < or = 0.004 inch, and (3) a guard ring surrounding a circular disc conductor pattern, when biased independently but at the same potential as the circular disc portions, confines the region of charge imaged by the disc to that region immediately behind the disc. Author (TAB)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-13906# Los Alamos Scientific Lab., N. Mex.
SOME DISCRETE TRANSFORMS AND THEIR CONTINUOUS ANALOGS
D. E. Nagle 2 Oct. 1967 4 p *ref*
(Contract W-7405-ENG-36)
(LA-3748) CFSTI: HC$3.00/MF$0.65

It is shown that the Cauchy, Taylor, and Laurent theorems, which refer to analytic functions, have discrete analogs which hold for arbitrary functions of the complex variable z, with the single restriction that the values of z divide the unit circle. Author (NSA)

N68-13987# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
THE EFFECT OF FINITE CHANNEL WIDTH ON SPECTRUM BROADENING DUE TO PULSE PILE-UP
John R. Lilley Jun. 1967 27 p refs Presented at Am. Nucl. Soc., San Diego, Calif., 12–15 June 1967
(Douglas Paper-4389)

Pulse pile-up theory was surveyed. The modifications in the usual pulse pile-up formulas caused by finite channel widths are discussed specifically. The effects on measured spectra were demonstrated with analyses based on the assumption of flat spectra within each channel. The physical relationships between the effect of finite channel width and other pile-up effects are also discussed in terms of the basic pulse shape. Author

N68-14203# California Univ., Berkeley. Lawrence Radiation Lab.
PWM CONTROL OF SERVOMOTOR WITH LINEAR FEEDBACK
Craig A. Denison and E. W. Owen 13 Jul. 1967 13 p refs Presented at the Asilomar Conf. on Circuits and Systems, Pacific Grove, Calif., 1–3 Nov. 1967
(Contract W-7405-ENG-48)
(UCRL-17617; CONF-671107-1) CFSTI: HC$3.00/MF$0.65

Because of the nonlinear nature of pulse-width-modulated (PWM)-controlled systems, there has been little success in specifying the coefficients for linear feedback to achieve a given performance criterion. One approach has led to a controller that is unrealizable for certain initial conditions, and the response has ripple between the sample instants. The author of another paper has mentioned a method of approximating the time-optimal feedback with linear feedback, but the approximation is unsatisfactory for large initial conditions. A definition for a linear PWM controller is proposed which has, approximately, the minimum response time for a given initial condition, or which can guarantee that there is no overshoot for all initial conditions. Author (NSA)

N68-14316# Sandia Corp., Albuquerque, N. Mex.
TABLE OF OUTPUT PROBABILITY DISTRIBUTIONS FOR A QUANTIZING ENVELOPE DETECTOR WITH A SINUSOIDAL SIGNAL IN GAUSSIAN NOISE AT THE INPUT
T. S. Edrington Sep. 1967 11 p refs
(Contract AT(29-1)-789)
(SC-R-67-1185) CFSTI: HC$3.00/MF$0.65

The quantizing envelope detector is a memory-less device with binary output: 1 if the input voltage exceeds a threshold, and 0 otherwise. This document provides probability distributions of the detector output when the input is a sinusoidal signal in Gaussian noise. Author (NSA)

N68-14460# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
MILLIDEGREE NOISE THERMOMETRY
Robert A. Kamper *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 5 p refs Sponsored in part by NASA (See N68-14447 05-23)

Since the linewidth of Josephson radiation is temperature dependent, its use for a millidegree noise thermometer is suggested. The model used has the Josephson junction connected in parallel with a small resistance which provides bias voltage, and both the junction and the bias resistor generate noise. The circuit for generating radio frequency Josephson radiation is shown, as is the spectrum of a frequency-modulated sine wave. The equipment could measure temperature down to one millidegree as long as there is no significant source of noise, independent of temperature, that could mask the effect of the bias resistor at low temperature. Such a thermometer would offer the advantage of good thermal contact. M.W.R.

N68-14634# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTINUOUS AND DISCRETE SERVOSYSTEMS
S. L. Popkov and Yu. S. Popkov 29 May 1967 270 p refs Transl. into ENGLISH of the book "Nepreryvnyye i Diskretnyye Sledyashchiye Sistemy" Moscow, Izd. Energiya, 1964 p. 1–304
(FTD-MT-65-516; AD-662551)

Book consists of two parts. In the first part are presented certain questions of theory and design of continuous servosystems

for regular and random imputs. In second part are illuminated basic questions of theory and design of relay and pulse servo systems. With regard to digital servosystems, different types of coding and decoding converters are considered. Appraisal of quality of digital servosystems is given. Author (TAB)

N68-14781 United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
NEUTRON GUIDES: A REPORT ON THE PRESENT STATE OF DEVELOPMENT
B. Alefeld, J. Christ, D. Kukla, R. Scherm, and W. Schmatz Aug. 1966 45 p refs Transl. into ENGLISH from German Rept. JUEL-294-NP
(AERE-TRANS-1074; JUEL-294-NP) HMSO: 6s

A discussion is presented on the development state of neutron guides suitable for beam pipes in nuclear reactors. A summary is given of previously derived relations, and it is shown that guides of 1 Å are practical. The influence of errors in assembly is treated generally, and a few of the questions concerning the technical assembly of long neutron guides are briefly discussed. C.T.C.

N68-14871 Joint Publications Research Service, Washington, D. C.
RESEARCH ON CONTROL THEORY SYSTEMS
8 Jan. 1968 14 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 175, no. 6, 1967 p 1238–1244
(JPRS-43910) CFSTI: $3.00

CONTENTS:

1. OPTIMAL CONTROL OF SYSTEMS WITH DISTRIBUTED PARAMETERS V. Plotnikov p 1–7 refs (See N68-14872 05-10)

2. SYNTHESIS OF AUTOMATIC SYSTEMS OPTIMAL IN THE MEAN A. I. Propoy and Ya. Z. Tsypkin p 8–13 refs (See N68-14873 05-10)

N68-14872 Joint Publications Research Service, Washington, D. C.
OPTIMAL CONTROL OF SYSTEMS WITH DISTRIBUTED PARAMETERS
V. Plotnikov *In its* Res. on Control Theory Systems 8 Jan. 1968 p 1–7 refs (See N68-14871 05-10)

Optimality criteria and a uniqueness theorem are formulated for a class of optimal problems in which the function is minimized. It is assumed that the controls are measurable vector functions with values from a certain bounded set of vector space, and that the right end of the trajectory is subjected to certain constraints. E.J.S.

N68-14873 Joint Publications Research Service, Washington, D. C.
SYNTHESIS OF AUTOMATIC SYSTEMS OPTIMAL IN THE MEAN
A. I. Propoy and Ya. Z. Tsypkin *In its* Res. on Control Theory Systems 8 Jan. 1968 p 8–13 refs (See N68-14871 05-10)

An algorithm is proposed for the synthesis of optimal control systems. In formulating the problem the form of the control law is predetermined except for a certain number of parameters. The step-by-step formulation of the problem is shown, and the assumptions used in obtaining it are briefly discussed. The complexity of the convergence of this algorithm is considered. E.J.S.

N68-14905# RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING AND SEQUENTIAL INTERPOLATING FILTERS FOR NONLINEAR PROCESSES
H. H. Kagiwada, R. E. Kalaba, A. Schumitzky, and R. Sridhar Nov. 1967 23 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5507-PR; AD-662317)

The study shows how a sequential solution can be obtained for a fairly general nonlinear interpolation problem using a least-squares criterion for estimation, along with invariant imbedding techniques. The equations of the sequential interpolating filter are obtained by first showing the interpolation problem to be equivalent to a two-point boundary-value problem. The two-point boundary-value problem is then converted to an initial-value problem by means of invariant imbedding, and the initial-value problem leads directly to a sequential filter. To avoid unnecessary matrix manipulations, the formulation and solution are given for the scalar case only. Generalization to the vector case is straightforward. Author (TAB)

N68-14915# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
STUDY OF MODELS IN LINEAR OPTIMAL CONTROL THEORY AND APPLICATION TO VARIABLE STABILITY AIRPLANE CONTROL SYSTEM Final Report
James S. Tyler, Jr. Nov. 1967 83 p refs
(CAL-IM-1836-F-1)

Explicit models are examined in the context of linear optimal control theory to see if their use can assist in control system synthesis in general, or if the modeling methods can be used to develop techniques for calculating the gains in variable stability airplanes. The theory underlying linear optimal control is reviewed and two methods are developed for incorporating models into the synthesis technique. The first method, called the model-in-the performance-index method, introduces the model only in the performance index. The type of system derived uses feedback gains to alter the controlled element or plant so that it behaves like the model. The second method, called the model-in-the-system method, incorporates in the performance index the response errors between the plant and a physical analog model of the desired plant. The type of system derived uses fee forward gains from the model and feedback gains from the plant to make the plant follow the model. Author

N68-14937# Air Force Cambridge Research Labs., Bedford, Mass.
A NOTE ON ASYNCHRONOUS QUENCHING
Edmond M. Dewan Aug. 1967 21 p refs *Its* Phys. Sci. Res. Papers, No. 337
(AFCRL-67-0453; Rept.-337; AD-662581)

Asynchronous quenching (AQ) is a type of asynchronous action that consists essentially in quenching a self-sustained (soft) oscillation by imposing an externally produced high-frequency perturbation on the oscillator. Minorsky treats this subject in his book, Nonlinear Oscillations, by using the stroboscopic method. Although this leads to a correct result (the self-sustained oscillation is quenched), there is a misleading aspect of the mathematical statement which tends to make the unwary reader jump to the conclusion that very high-frequency perturbations can quench an oscillation, leaving behind only a DC solution. As will be shown, this is false, and AQ turns out to be nothing other than harmonic entrainment at large detuning. Author (TAB)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-14039# Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center.
LIQUID METAL ENGINEERING CENTER (LMEC) Quarterly Technical Progress Report, Apr.–Jun. 1967
15 Aug. 1967 98 p refs
(Contract AT(04-3)-700)
(NAA-SR-12520) CFSTI: HC $3.00/MF $0.65

Progress is reported on preparation of engineering standards and specifications and practices for liquid metal systems and components. Design studies for the LMEC data acquisition and processing center are reported along with operation of the Sodium Component Test Installation including repairing the sodium heater. Operation of the Liquid Metals Information Center and the Sodium Pump Test Facility is described. The Sodium Pump Bearing and Seal Test Program in which the test rig design was completed and component design is nearing completion is discussed. Sliding friction and wear tests were made in liquid sodium for a number of materials. Operation of gears and bellows in sodium was investigated. Design of the B and W steam generator progressed. Methods for high temperature strain measurements were developed. Information is also included on laboratory support and maintenance of temporarily idle equipment. NSA

N68-14050# Stanford Univ., Calif. Linear Accelerator Center.
BUBBLE CHAMBER ONE-AND-A-HALF METERS IN DIAMETER WITH A SUPERCONDUCTING MAGNET, FILLED WITH HYDROGEN, DEUTERIUM, OR HELIUM (SUBSTANTIATION AND DRAFT) [POLUTORAMETROVAYA PUYYRIKOVAYA KAMERA SO SVERKHPROVOLYASHCHIM MAGNITOM, ZAPOLNYAEMAYA VODORODOM, DEITERIEM ILI GELIEM (OBOSNOVANIE I ESKIZIVI PROEKT]
A. V. Belonogov, I. A. Vetlitskii, V. M. Guzhavin, V. M. Dobrov, G. K. Kliger et al 1967 58 p refs Transl. into ENGLISH from Russian Rept. ITEF-496
(SLAC-TRANS-72; ITEF-496) CFSTI: HC $3.00/MF $0.65

The design of a bubble chamber 1.5 meters in diameter and 1.6 cubic meters in volume, with a superconducting magnet creating a 60- to 80-kg field, is examined. Uses of the chamber, accuracy of experimental data obtained from the chamber, the technical feasibility of manufacturing its subassemblies, and an estimate of the cost of building the chamber complex are presented. NSA

N68-14071# California Univ., Livermore. Lawrence Radiation Lab.
ASTRON APPROACH TO CONTROLLED FUSION
N. C. Christofilos 24 Apr. 1967 25 p *ref* Presented at the Meeting of the Am. Phys. Soc., Washington, D. C., 24–27 Apr. 1967 Sponsored by AEC
(UCRL-70450; CONF-670414-4) CFSTI: HC $3.00/MF $0.65

The fundamental concepts of the Astron device for controlled fusion research are described. A general description of the facility is given. NSA

N68-14104# Avco-Everett Research Lab., Everett, Mass.
QUARTERLY PROGRESS REPORT, 26 JUNE–25 SEPTEMBER 1967
Oct. 1967 22 p refs
(Contract AT(30-1)-3863)
(NYO-3863-1) CFSTI: HC $3.00/MF $0.65

Using the existing toroidal apparatus, an extensive series of experiments aimed at clarifying the detailed factors influencing charge injection was carried out. A new high-vacuum toroidal device for studying long-time containment of electron clouds is briefly described. NSA

N68-14105*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE 10-FT SPACE SIMULATOR AT THE JET PROPULSION LABORATORY
Douglas E. Lund 15 Dec. 1967 24 p *ref*
(Contract NAS7-100)
(NASA-CR-91733; JPL-TR-32-1231) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The vacuum chamber simulator, vacuum system (compressor plant, mechanical, and diffusion pumping), solar simulation, cryogenic, and supporting systems for the 10-ft space simulator facility, are described. Facility instrumentation systems for measuring pressure, solar radiation, and temperature; and for handling of data, are also described. Technical information required for proper planning of simulator tests is given. L.S.

N68-14115*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A 4500°R (2500°K) FLOWING-GAS FACILITY
Jack G. Slaby, Byron L. Siegel, William F. Mattson, and William L. Maag Washington Jan. 1968 32 p refs
(NASA-TM-X-1506) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The design and operation of a high-temperature flowing-gas heater is described. The heater consists of four identical heater stages, each individually controlled. The heating elements consist of flat tungsten plates which are electrically resistance heated by high direct-current power supplies and operate at surface temperatures above 5000°R (2780°K). The maximum power that can be transferred to the gas is about 1.5 megawatts. The gas flows through the four heater stages in series. Gas temperatures exceeding 4500°R (2500°K) were obtained with hydrogen, helium, and nitrogen. Operating life of the heater elements was 10 hours or more. Power supply selection; connection of high current busing to the heater; heater expansion at operating temperature; materials compatibility, and heater surface temperature profiles associated with the physical dimensions of the heater, are discussed. Author

N68-14269# Stanford Univ., Calif. Linear Accelerator Center.
PULSE SHORTENING IN A TWO-SECTION LINEAR ACCELERATOR
V. A. Vishnyakov, A. I. Zykov, V. M. Grizhko, and I. A. Grishaev Aug. 1967 14 p refs Transl. into ENGLISH from Russian Rept.-227/VE-063
(SLAC-TRANS-74) CFSTI: HC $3.00/MF $0.65

An investigation of shortening of the current pulse on a two-section linear electron accelerator is presented. The experimentally investigated effects of various factors on the character of the destruction of the beam are discussed. It is concluded that in designing strong-current accelerators, preference must be given to diaphragmatic waveguides with a low serial impedance in the hybrid wave. NSA

N68-14283 Gt. Brit. National Inst. for Research in Nuclear Science, Chilton.
OPTIMIZATION OF BUBBLE CHAMBER DESIGN PARAMETERS: MEASURING ACCURACIES FOR CHARGED PARTICLES
C. M. Fisher *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 23 p (See N68-14281 05-24)

Bubble chambers working at high energy sources of neutrino and antineutrino beams require: (1) an increased magnitude in chamber volume; (2) an increased magnetic field; and (3) a combination bubble chamber with a triggered spark chamber. A low energy optimization for the hydrogen/deuterium chamber is first described and then extended to the analysis of higher energies. G.G.

N68-14285 Ecole Polytechnique, Paris (France).
THE LARGE HEAVY LIQUID BUBBLE CHAMBER "GARGAMELLE": PHYSICAL ASPECTS AND EXPERIMENTATION
P. Musset *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 14 p (See N68-14281 05-24)

Described is a cylindrically shaped heavy liquid bubble chamber with a length of 4.8 m; its total volume is 12 m^3, and its useful volume as seen by cameras is 10 m^3. Its vertical magnetic coils give a horizontal field which is perpendicular to the axis of the cylinder. The chamber may be filled with pure freon, pure propane, or any mixture of propane and freons for the required interaction and radiation length of proposed experiments on neutral particles, charged particles, free proton density, and particle identification techniques. G.G.

N68-14286 Argonne National Lab., Ill.
PHYSICS PLANS FOR THE 12-FT. HYDROGEN BUBBLE CHAMBER
M. Derrick and R. A. Burnstein (Ill. Inst. of Technol.) *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 8 p Sponsored by AEC (See N68-14281 05-24)

The schematics of a possible neutrino layout for a 12-ft bubble chamber and an accelerator providing pions up to 12.4 GeV/c are given. The extracted proton beam is focused on a cylindrical current sheet that in turn focuses positive or negative secondary particles according to the direction of the current flow. The beam of mesons decays and thus produces a neutrino beam. Neutrino spectrums are calculated from the known angle-momentum spectra of the pions and kaons by Monte Carlo method; results are given for neutrino distributions perpendicular to the beam direction and show that the 12-ft chamber is fairly matched to the beam produced by a 300 KA sheet current. G.G.

N68-14287 Argonne National Lab., Ill.
STATUS OF ANL 12-FT. HYDROGEN BUBBLE CHAMBER
E. G. Pewitt *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 6 p Sponsored by AEC (See N68-14281 05-24)

Design characteristics of a 12-ft hydrogen bubble chamber incorporate a superconducting coil and four cameras located in a 7-ft-diameter circle in the chamber top. The expansion system of the chamber consists of a near-full diameter piston connected to the chamber walls by a toroidal bellows; hydrogen heat exchanges located at the top of the chamber insure temperature control. G.G.

N68-14288 European Organization for Nuclear Research, Geneva (Switzerland).
THE LARGE EUROPEAN HYDROGEN BUBBLE CHAMBER
R. Florent *In its* Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 7 p (See N68-14281 05-24)

The present design for a large European bubble chamber encompasses a 60 Kilo Gauss, 40 cm inside diameter coil for testing superconducting strips under mechanical stress, and the construction of a 1 meter model chamber without magnet. Present design drawings consider a vertical axis, scotchlite optics with four cameras, a plastic piston, a light separation disk in the bottom, superconducting coils in separate dewars, and magnetic shielding. G.G.

N68-14289 Commissariat a l'Energie Atomique, Paris (France).
THE LARGE HEAVY LIQUID BUBBLE CHAMBER "GARGAMELLE": TECHNICAL ASPECTS AND PLANNING
L. Alfille *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 23 p (See N68-14281 05-24)

Technical aspects and construction planning for a large heavy liquid bubble chamber, intended to run with a 28 GeV proton synchrotron, are developed for a 1/8 scale model. The model chamber body is a 12 cubic meter cylinder with a horizontal axis of 1.88 m internal diameter and of 4.80 m length. Xenon flashes supply direct illumination of the tracks in the chamber and two cameras mounted parallel to the axis of the chamber provide photographic tracking of the particles. Runs with freon at 30°C, propane at 60°C, or with various mixtures of heavy liquids are proposed. G.G.

N68-14290 Commissariat a l'Energie Atomique, Saclay (France).
THE HYDROGEN BUBBLE CHAMBER "MIRABELLE"
M. Beauval *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 12 p (See N68-14281 05-24)

Design drawings for a liquid hydrogen bubble chamber with a visible volume of 6,000 liters are presented, and the construction of a full-scale model is described. Evaluation tests on the model will determine the characteristics of the final huge bubble chamber; main differences will be in the external structure which has to be adapted to the magnetic field. Most of the functional units will be re-employed in the final chamber. G.G.

N68-14291 Gt. Brit. National Inst. for Research in Nuclear Science, Chilton.
RHEL—1.5 M BY 70 KG HYDROGEN BUBBLE CHAMBER
D. B. Thomas *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 19 p ref (See N68-14281 05-24)

Described is the development of a 1.5 m by 70 kG hydrogen bubble chamber for experiments with a proposed 300 GeV accelerator. The chamber will have two beam entry directions, a median plane entry for high momentum beams and an on-axis entry for beams of about 1 GeV/c or less. The chamber vessel is cylindrical shaped, its optics are positioned at the base, and its thick magnetic coils will provide a rather modest current density to ensure a reasonable interval stress level. A general assembly diagram for the chamber is shown. G.G.

N68-14292 Brookhaven National Lab., Upton, N. Y.
14-FOOT BUBBLE CHAMBER RESEARCH AND DEVELOPMENT PROGRAM: OVER-ALL PLAN AND OPTICS DETAILS
R. I. Louttit *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 13 p (See N68-14281 05-24)

Development and testing of a half-scale model for a 14-foot hydrogen bubble chamber design is reported. The test chamber vessel has a visible volume of 6,000 liters, three camera ports located at 120° intervals on a circle 5 feet in diameter, a fiberglass reinforced plastic piston at the bottom, and refrigeration loops over the entire dished head at the top of the chamber. Relative motions of the vacuum tank, the chamber, the magnet, and the earth are calculated under the assumption that the expansion force can be represented by Fourier transformation. Results indicate some high stress amplitudes during operation, necessitating increased cross section designs for all support. A test run with a chamber filled by an atomic neon–hydrogen mixture and a free piston in which the chamber liquid does the work of expanding produced a fairly wide range of acceptable pictures. G.G.

N68-14293 European Organization for Nuclear Research, Geneva (Switzerland).
A ONE METRE HYDROGEN TEST BUBBLE CHAMBER

J. Schmid *In its* Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 9 p (See N68-14281 05-24)

Optical and thermodynamic properties of a proposed hydrogen test bubble chamber of 1 m diameter are evaluated for their uniformity. Low cooling of the piston region is emphasized in order to insure a proper dynamic heat load and to suppress spurious bubbles; a versatile expansion system will provide the optimum expansion time constants for the expansion pulse; the vibration energy of the disk will be recovered integrally by the expansion piston; and a bellows sealed piston of full chamber diameter will be tried out. G.G.

N68-14294 Gt. Brit. National Inst. for Research in Nuclear Science, Chilton.

A PROPOSAL FOR A MAMMOTH HYDROGEN BUBBLE CHAMBER FOR USE WITH THE 300 GEV MACHINE

D. B. Thomas *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 7 p (See N68-14281 05-24)

Construction parameters for a proposed giant hydrogen chamber design of about 15 meter diameter and 6 meter depth are depicted. This preliminary design features an underground beam transport system for a 300 GeV accelerator and strong cylindrical bubble chamber walls constructed with glass cloth-epoxy lamination techniques. The large superconducting coils with internal diameters of several meters are enclosed in plastic tubes and cooled by liquid helium flow. A honeycomb plastic layer is suggested for thermal insulation between the surrounding concrete bed and the liquid hydrogen and liquid helium. The optical system consists of concentric windows placed on the base of the chamber remote from the heat exchangers at the top; retrodirective illumination based on bright field or possible dark field Scotchlite will be used. G.G.

N68-14324# Los Alamos Scientific Lab., N. Mex.

RESONANT SIDE-COUPLED CAVITY ELECTRON ACCELERATORS

E. A. Knapp, W. J. Shlaer, G. R. Swain, and J. M. Potter 5 Sep. 1967 18 p refs Presented at the 6th Intern. Conf. on High Energy Accelerators, Cambridge, Mass., 11–15 Sep. 1967

(Contract W-7405-ENG-36)

(LA-DC-8834; MP-3-4; CONF-670930-9) CFSTI: HC $3.00/MF $0.65

The performance of two $\pi/2$-mode electron linear accelerators already constructed, and progress on the construction of a 20-MeV, high-current, high-duty-factor linear accelerator are described. The $\pi/2$-mode accelerators are designed with side-coupled cavity chains to stabilize the electromagnetic field distributions. The 20-MeV high-current electron linear accelerator is being built to investigate some of the problems associated with the construction of the LAMPL. (NSA)

N68-14333# California Univ., Berkeley. Lawrence Radiation Lab.

THE OMNITRON: A MEDIUM-ENERGY SYNCHROTRON FOR THE ACCELERATION OF LIGHT AND HEAVY IONS

F. T. Cole and R. M. Main Sep. 1967 27 p refs Presented at the 6th Intern. Conf. on High Energy Accelerators, Cambridge, Mass., 11–15 Sep. 1967

(Contract W-7405-ENG-48)

(UCRL-17869; CONF-670930-15) CFSTI: HC $3.00/MF $0.65

A novel guide-magnet configuration has been devised that makes possible the acceleration of all charge-to-mass ratios from 0.04 to 1. A concentric storage ring, with the associated beam-switching equipment, allows for the extension of beam duty factor to essentially 100%. The storage ring can also be used in a bootstrap acceleration of heavy ions in which the ions are injected at low e/m, accelerated to a moderate velocity, stored while the accelerating ring returns to minimum field, stripped to maximum e/m, and reinjected for further acceleration. With a pressurized 3.0-MV Cockcroft–Walton injector, the proposed system is capable of accelerating all ions from protons to uranium—to energies up to 1.5 BeV for protons and 0.3 to 0.5 BeV/nucleon for the heavier ions. Intensities of 10^{12} to 10^{13} nucleons/sec for the lighter ions ($M \leq 128$) are anticipated. The heavy-ion charge-exchange probabilities determine the vacuum requirements of this system. To minimize these requirements and to increase beam intensity, a 60 cps cycling rate has been chosen. The vacuum requirements and the special rf resonator and beam-switching problems attendant with the high cycling rate are discussed. Author (NSA)

N68-14338# Atomic Energy of Canada, LTD., Chalk River (Ontario).

THE AECL STUDY FOR AN INTENSE NEUTRON GENERATOR Status Report, Jul. 1967

T. G. Church, ed. Jul. 1967 197 p refs

(AECL-2750) CFSTI: HC $3.00/MF $0.65

A project study for a proposed intense neutron generator is presented. The design of a high-current proton linear accelerator, a high-flux thermal neutron facility, and a meson facility is presented. Shielding, safety systems, research and technical applications, commercial isotope production, and project engineering are discussed in detail. NSA

N68-14366 Southampton Univ. (England). Dept. of Aeronautics and Astronautics.

THE EFFECT OF WIND TUNNEL SIZE ON THE POWER AND VOLTAGE REQUIREMENTS OF MAGNETIC SUSPENSION SYSTEMS

M. Judd May 1967 16 p refs

(A.A.S.U.-269)

A method has been developed for the rapid estimation of the effect of tunnel scale on the power and voltage requirements of magnetic suspension systems. It is used in conjunction with values obtained from existing equipment. The method covers such loads as weight, inertia, steady and unsteady aerodynamic forces and moments but does not give an optimum design. Author

N68-14409# Argonne National Lab., Ill.

UNILAC: A LINEAR ACCELERATOR FOR ATOMIC IONS OF ANY MASS

Oct. 1967 18 p refs Transl. into ENGLISH from German

(ANL-TRANS-533) CFSTI: HC $3.00/MF $0.65

A brief description of the UNILAC linear accelerator for acceleration of all nuclei up to uranium is presented. Design considerations and preliminary cost estimates are included. NSA

N68-14539# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Institut.

INCREASE OF THE LIMITING PULSED CURRENT IN A LINEAR ELECTRON ACCELERATOR [UVELICHENIE PREDEL'NOGO IMPUL'SNOGO TOKA V LINEINOM USKORITELE ELEKTRONOV]

V. A. Vishnyakov, A. I. Zykov, I. A. Grishaev, and V. M. Grizhko 1967 6 p refs In RUSSIAN

(NP-17078; Rept.-308/VE-071)

It was shown experimentally that the limiting value of the pulsed current increases in proportion to the increase in the number of sections making up accelerators composed of diaphragmatic wave-guides with uniform parameters of the periodic structure. It

is proposed that the sections be as short as possible or that long accelerating sections be composed of short subsections connected by means of hybrid E_{11} and H_{11} wave filters. NSA

N68-14570 Royal Aircraft Establishment, Farnborough (England).
TEST TECHNIQUES: GROUND-AIR ENGINE, PROPELLED CARRIER, AND FREE FALL MODEL [TECHNIQUES D'ESSAI: CHARIOT PROPULSE, ENGIN SOL-AIR ET MANNEQUIN LARGUE EN CHUTE LIBRE]
W. G. Molyneux *In* ONERA Aeroelasticity Manual, Vol. 4 [1967] 22 p refs (See N68-14561 05-32)

Detailed descriptions are given on three test techniques for calculating aeroelasticity, and the test conditions and relative advantages of each are discussed. These are (1) the rocket propelled sled method conducted at ground level to study acceleration; (2) a ground–air device for observing the model in free flight; and (3) a large prototype for observing the range of air densities associated with variations in aerodynamic speeds and Mach numbers in free fall. Methods of measuring speeds are also described, with details given on the specific equipment used for the three techniques. Various model configurations are assessed, and the problems involved in analyzing the recorded data are considered. Transl. by M.G.J.

N68-14575# Kaman Aircraft Corp., Colorado Springs, Colo. Nuclear Div.
LONG LIVED TARGETS
P. L. Jessen 19 Sep. 1967 15 p ref Presented at 3d Meeting on Accelerator Targets Designed for Production of Neutrons, Liege, 18–19 Sep. 1967
(KN-67-655(R))

Target materials to be used in sealed miniature ion accelerators for neutron production were investigated. The differences in requirements and operation between the sealed accelerators and the conventional Cockroft–Walton equipment are indicated, and the difficulties in using zirconium or titanium hydride targets in sealed accelerators are described. The variation of hydrogen solubility with temperature and the relative efficiencies are given for copper, manganese, nickel, and titanium. The evaluation methods are outlined, and yield data for the copper targets over periods of operation and storage are discussed. It is felt that the operational data for the copper targets in sealed accelerators indicate significant advantages in terms of lifetime and pressure stability. It is further considered that the use of sealed accelerators with low efficiency targets appears economically attractive. N.E.N.

N68-14587# European Organization for Nuclear Research, Geneva (Switzerland).
THE DESIGN STUDY OF A 300 GEV PROTON SYNCHROTRON
R. Billinge, M. H. Blewett, W. Hardt, M. G. N. Hine, P. M. Lapostolle et al 30 May 1967 110 p refs
(CERN-702; CERN-563)

A supplementary study to CERN-563 is presented. Additional site studies, developments in the design of the injection system, and experimental exploitation studies are discussed. Also, the cost estimates are updated. NSA

N68-14599# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
DESIGNING OF THE ELECTRON MODEL MAGNETIC SYSTEM OF A STRONG FOCUSING CYCLOTRON [RAZRABOTKA MAGNITNOI SISTEMY ELEKTRONNOI MODELI TSIKLOTRONA S ZHESTKOI FOKUSIROVKOI]
S. B. Vorozhtsov, N. L. Zaplatin, and L. A. Sarkisyan 1967 34 p refs In RUSSIAN
(JINR-P9-3448)

The results are given of the designing of the magnetic system current coils for a strong-focusing cyclotron ($Qr,z>1$). The magnetic system is intended for the experimental investigation of the space charge influence on proton motion in the relativistic high-current cyclotrons. Author (NSA)

N68-14602# Yale Univ., New Haven, Conn. Gibbs Lab.
PULSED SOURCE OF HIGHLY POLARIZED ELECTRONS
V. W. Hughes, M. S. Lubell, M. Posner, and W. Raith Sep. 1967 10 p refs Presented at the Proc. of the 6th Intern. Conf., Cambridge, Mass., Sep. 1967
(Contract AT(30-1)-2726)
(Yale-2726-501; CONF-670930-13) CFSTI: HC $3.00/MF $0.65

An atomic beam system for producing polarized electrons by photoionization of a polarized lithium-6 beam is presented. The system consists of a polarized atom source, an ultraviolet light source, and an ionization region. A pulsed source of polarized electrons with high intensity and high polarization, suitable for use with a high-energy accelerator, was produced with the system. Author

N68-14604# California Univ., Berkeley. Lawrence Radiation Lab.
SELECTION OF INJECTOR SYSTEMS
J. M. Peterson 12 Sep. 1967 21 p Presented at the 6th Intern. Conf., Cambridge, Mass., Sep. 1967
(Contract W-7405-ENG-48)
(UCRL-17798; CONF-670930-17) CFSTI: HC $3.00/MF $0.65

A discussion of injector systems considered for a strong-focusing 200-GeV proton synchrotron is presented. Systems discussed include a 2-BeV linac, fast booster, slow booster, slow Quart, and fast Quart–fast booster. NSA

N68-14649 Mitsubishi Heavy Industries, Ltd., Tokyo (Japan).
STUDY ON THE HEAT INSULATING EFFECT OF METALLIC FOIL
Tomio Yamaguchi (Kobe Tech. Inst.), Hisayoshi Fukue (Kobe Tech. Inst.), and Isao Mitsutaka (Kobe Tech. Inst.) Jul. 1967 10 p refs
(MTB-010050)

In the construction of air conduit such as that of the blow-down type hypersonic wind tunnel, in which there are intermittent flows of high-temperature high-pressure air, it is essential that pipe walls should be fully protected against high temperature and at the same time heat loss in the conduit be as small as possible. From this viewpoint, we adopted multilayer heat resistant metallic foil in a hypersonic wind tunnel. The authors make a theoretical analysis of the thermal insulating effect of metallic foil and also make clear the relations between the number of metallic foil layers and temperature rise of pipe walls, heat loss, and flow rate. We carried out experiments with several test pieces having different numbers of metallic foil layers on the inner surface. The experimental results coincided very well with the theoretical results. In the actual hypersonic wind tunnel (air temperature 1000°C, air pressure 100 kg/cm^{2}G), metallic foil layers were installed on the inner surface of the pipes and on the shut-off valve and stilling chamber, which showed good insulating effect in a test run. Author

N68-14704# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
COLLECTIVE LINEAR ACCELERATION OF IONS [KOLLEKTIVNOI LINEINOE USKORENIE IONOV]

V. I. Veksler, V. P. Sarantsev, A. G. Bonch-Osmolovskii et al 1967 15 p refs In RUSSIAN
(JINR-P9-3440-2)

The possibility of building an accelerator based on a collective principle of acceleration is theoretically considered and proved by experiment. The methods of creation of a bunch with a large number of particles, its acceleration, and the stability of its size are considered. Certain conditions for the particle concentration as well as for the external electromagnetic fields, at which it is possible to obtain a bunch of an optimum size, are drawn from the calculation of the bunch stability. The experiments performed agree with the calculation data. A choice of the accelerating system, for which the calculations of the effective electrical fields are made, is verified. It is shown that these fields exceed considerably those obtained in other accelerators. Author (NSA)

N68-14705# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
LONGITUDINAL TOLERANCES IN THE ACCELERATING STRUCTURE OF THE 10 MEV SWIERK PROTON LINEAR ACCELERATOR [TOLERANCJE WZDLUZNE W STRUKTURZE PRZYSPIESZAJACEJ AKCELERATORA LINIOWEGO PROTONOW 10 MEV W SWIERKU]
J. Sura 1967 20 p In POLISH; ENGLISH summary
(INR-790/SLBAL/PL)

The tolerances of the accelerating field distribution and drift tube alignment are determined. The respective values are $\delta E_0/E_0 = 1.7\%$ and $\delta Z/\gamma\beta = 0.12\%$. The method of calculation of field correction is given. The effects of vibrations of accelerating structure elements are discussed. Author (NSA)

N68-14708# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
RING ACCELERATOR WITH STRONG FOCUSING FOR MULTICHARGED IONS [KOL'TSEVOI TSIKLOTRON S ZHESTKOI FOKUSIKOVKOI DLYA MNOGOZARYADNYKH IONOV]
V. P. Dzhelepov, V. P. Dmitrievskii, B. I. Zamolodchikov, and V. V. Kol'ga 1967 13 p refs In RUSSIAN Submitted for Publication
(JINR-P9-3443)

A possible use of a ring cyclotron with strong focusing for the acceleration of multicharged ions is considered. The ions with the mass number $A \geq 40$ can be accelerated up to 6–8 MeV/nucl. Two variants of the ring cyclotron with the maximal diameter 10m and 4.2m are calculated. The second variant is intended for acceleration of ions up to uranium ions. Author (NSA)

N68-14711# Los Alamos Scientific Lab., N. Mex.
PROSPECTS AND USES FOR MESON FACTORIES
Louis Rosen [1967] 32 p refs Presented at the 6th Intern. Conf. on High Energy Accelerators, Cambridge, Mass., 11–15 Sep. 1967
(Contract W-7405-ENG-36)
(LA-DC-9016; CONF-670930-10) CFSTI: HC $3.00/MF $0.65

A comparison of some proposed meson factory accelerators is presented, and experimental research using meson factories is discussed. The LAMPF proton linear accelerator, designed to produce 1-mA average current of 800-MeV protons, is described. NSA

N68-14743# Brookhaven National Lab., Upton, N. Y.
CONTENT OF ATMOSPHERIC RADIOLYSIS PRODUCTS IN THE OPERATING CHAMBERS OF POWER GAMMA-RADIATION INSTALLATIONS
M. T. Dmitriev and O. I. Yurasova Sep. 1967 8 p refs Transl. into ENGLISH from Gigiena i Sanit. (Moscow), v. 32, no. 3, 1967 p 112–114
(BNL-TR-160) CFSTI: HC $3.00/MF $0.65

The forced-draft ventilating system for the operating chamber of the gamma-irradiator used at the All-Union Research Institute for Canning and Vegetable Drying was investigated. The concentrations of ozone and nitrogen oxides were checked for health protection. The ozone concentration was found to be higher than the maximum allowable concentration. NSA

N68-14754# Brookhaven National Lab., Upton, N. Y.
PERFORMANCE REPORT ON THE AGS
R. R. Adams, R. L. Cassel, C. H. Distenfeld et al [1967] 24 p refs Presented at the 6th Intern. Conf. on High Energy Accelerators, Cambridge, Mass., 11–15 Sep. 1967
(BNL-11766; CONF-670930-14) CFSTI: HC $3.00/MF $0.65

A brief description of the Brookhaven AGS, its performance, and current developments are presented. An increase in beam intensity and related radiation effects are discussed. Accelerator improvements and component modifications are described, and a proposed slow external beam system is discussed. NSA

N68-14777# Stanford Univ., Calif. Linear Accelerator Center.
INCREASING THE CURRENT PULSE LIMIT IN A LINEAR ELECTRON ACCELERATOR
V. A. Vishnyakov, A. I. Zykov, I. A. Grishaev, and V. M. Grizhko Sep. 1967 7 p refs Transl. into ENGLISH of Akad. Nauk URSR, Kharkov, Fiz.-Tekhn. Inst. Rept. No. 308/VE-071
(SLAC-TRANS-76; Rept.-307/VE-071) CFSTI: HC $3.00/MF $0.65

It is demonstrated experimentally that the increase of the number of sections of which the linear accelerator consists increases about the same number of times the limit value of the pulse current. It is intended to compose long accelerating sections of short subsections, connecting them by means of hybrid EH_{11} wave filters. Author (NSA)

N68-14778# Stanford Univ., Calif. Linear Accelerator Center.
QUESTIONS CONCERNING THE INCREASE OF THE LIMITING CURRENT IN MULTISECTION LINEAR ACCELERATORS
V. A. Vishnyakov, A. I. Zykov, I. A. Grishaev, and L. A. Makhnenko 1967 7 p refs Transl. into ENGLISH of Akad. Nauk URSR, Kharkov, Fiz.-Tekhn. Inst. Rept. No. 309/VE-072
(SLAC-TRANS-77; Rept.-309/VE-072) CFSTI: HC $3.00/MF $0.65

A description is given of the experiment on increasing the limiting current in a multisection linear accelerator upon the replacement of the first accelerating section with a section in which the frequency of the hybrid EH_{11} wave differs from the frequency of hybrid waves excited by the beam in the remaining sections by 180 megacycles. This modification of the accelerator enables us to triple the pulse current, with which the shortening of the current pulse begins. Author (NSA)

N68-14855# Los Alamos Scientific Lab., N. Mex.
STABILIZATION OF THE DRIFT TUBE LINAC BY OPERATION IN THE $\pi/2$ CAVITY MODE

D. A. Swenson, E. A. Knapp, J. M. Potter, and E. J. Schneider 31 Aug. 1967 17 p refs Presented at the 6th Intern. Conf. on High Energy Accelerators, Cambridge, Mass., 11–15 Sep. 1967
(Contract W-7405-ENG-36)
(LA-DC-8848; MP-3-3; CONF-670930-11) CFSTI: HC $3.00/MF $0.65

The design and performance of a resonant coupling system for the drift tubes in a linear accelerator are discussed. The resonant coupling system converts the tank to resonant $\pi/2$-mode operation and is designed to stabilize the field against perturbations. NSA

N68-14878* Scientific Translation Service, La Canada, Calif.
DESIGN AND CONSTRUCTION OF THE 50CM HYPERSONIC WIND TUNNEL AT NATIONAL AEROSPACE LABORATORY
Washington NASA Nov. 1967 79 p refs Transl. into ENGLISH from JAPANESE Rept. TR-116, Tokyo, Mar. 1966 69 p
(Contract NASw-1496)
(NASA-TT-F-11206; TR-116) CFSTI: $3.00 CSCL 14B

This report describes the development and construction of the new hypersonic wind tunnel at National Aerospace Laboratory. The tunnel is of intermittent blow-down type, and a hypersonic flow is obtained by blowing high pressure air down either to the atmosphere or to a vacuum tank. Tunnel supply air of 200kg/cm^{2}G is obtained by the air supply system consisting of a compressor, driers, and high pressure vessels having the total volume of 12m^3 which is to be increased to 18m^3 by the end of this year. Vacuum pumps and a vacuum tank of 1,150m^3 are also equipped for vacuum driven operation. An alumina pebble-bed heater is used to heat the high pressure air up to a temperature of 1000°C. The tunnel is equipped with four interchangeable solid axisymmetric nozzles having nominal Mach numbers of 5, 7, 9 and 11, respectively. The test section is a circular free jet of 50cm in diameter surrounded by a test chamber. Digital data handling system including a computer is also installed. The construction has been completed and the tunnel is now under test run. Author

N68-14955*# Air Force Eastern Test Range, Patrick AFB, Fla.
MISSION SUPPORT BY THE DEPARTMENT OF DEFENSE
Royce G. Olson *In* NASA. Manned Spacecraft Center Gemini Sum. Conf. 1967 p 185–195 (See N68-14941 05-30)

Department of Defense (Air Force) mission support activities for the Gemini Program are summarized. Considered are the following areas of support responsibility: launch, network, recovery, communications, ground medical (biomedical), meteorological, public affairs, and miscellaneous logistics. S.C.W.

N68-14961*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ASTRONAUT FLIGHT AND SIMULATION EXPERIENCES
Thomas P. Stafford and Charles Conrad, Jr. *In its* Gemini Sum. Conf. 1967 p 321–328 (See N68-14941 05-30)

Presented is a discussion of astronaut flight simulator training techniques used for the Gemini Program, and actual experiences during orbital flight. Astronaut simulator training for the launch and rendezvous phases, and the performance of special tasks, is considered. Special tasks included experiment training; Gemini Agena target vehicle training; tether dynamics; systems operation; and reentry phase training. Flight experiences showed that the majority of the simulators were of a high fidelity and that, in most cases, the simulators produced accurate conditions of the actual flight. The few minor discrepancies between the responses, controls, and displays in the simulator and in the actual spacecraft had no noticeable effect on flight crew performance. On the basis of these studies it is concluded that: (1) Knowledge gained in the Gemini Program will provide the simulation and training guidelines for the Apollo Program. (2) High fidelity Apollo simulations and adequate flight crew training can allow the completion of the lunar landing mission with a minimum number of actual space flights. (3) The lunar descent and landing phase, which is the only phase of the lunar mission that has not been previously experienced to a great degree in the Gemini Program, cannot be experienced in flight until the actual landing takes place. (4) An accurate simulation can be provided to give the flight crews a realism that will closely approximate the actual lunar landing. S.C.W.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-13964* Pennsylvania State Univ., University Park. Systems and Controls Lab.
[RESEARCH AND DEVELOPMENT OF ON-BOARD SYSTEMS AND ELEMENTS FOR AEROSPACE VEHICLES] Research Report, Period Ending 30 Sep. 1967
J. L. Shearer Oct. 1967 13 p refs
(Grant NGR-39-009-023)
(NASA-CR-91679; RR-6) CFSTI: $3.00 CSCL 20D

Efforts to synthesize analytical and experimental methods in research and development of advanced engineering systems are reviewed. Summary data are presented on projects being conducted to (1) obtain a simplified mathematical model describing the dynamic response of a fluid transmission line with friction for various types of line inputs and line configurations; (2) relate the dynamics of free turbulent jets to the profile changes; (3) treat velocity profiles existing at diffuser stall–flow conditions as being composed of a small-eddy wall component and a large-eddy wake component; (4) evaluate low speed air test data on the hydraulic stepping motor; and (5) develop design concepts for the pneumatic stepping motor. The installation of a general purpose digital computer is reported. M.G.J.

N68-14002 General Electric Co., Philadelphia, Pa. Missile and Space Div.
COMPARISON OF LAMINAR AND TURBULENT CONE BOUNDARY LAYER FLOW WITH AND WITHOUT PRESSURE GRADIENT
B. C. Graber, H. E. Weber, and E. J. Softley Nov. 1967 38 p refs
(R67SD49)

This paper presents a comparison of laminar and turbulent boundary layer data at a local Mach number of 10 for a nominal zero pressure gradient flow versus a highly favorable pressure gradient flow. The data is obtained in similar shock tunnel facilities on a 5° half angle, sharp cone. Surface heat transfer and boundary layer total pressure profiles are measured and compared. Various theoretical prediction methods are compared to the turbulent heat transfer results with the reference enthalpy approach giving the best results. Analysis of the data indicates a significant contribution to both laminar and turbulent boundary layer surface heat transfer due to a favorable pressure gradient while comparison of the boundary layer total pressure profiles indicates local boundary layer similarity. Author

N68-14020* Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
STUDIES OF THE BOUNDARY LAYER, WITH NATURAL AND INDUCED TURBULENCE, IN THE CASE OF SUPERSONIC FLOW ALONG A FLAT PLATE
Jean-Francois Dorand Washington NASA Jan. 1968 106 p refs Transl. into ENGLISH from Publ. Sci. Tech. Min. Air (France), no. 355, 1959 106 p
(Contract NASw-1692)
(NASA-TT-F-11359) CFSTI: $3.00 CSCL 01A

The experimental study of the establishment of turbulence on a flat plate located in a supersonic flow at Mach 1.85 was conducted with the aid of dynamic and thermal investigations of the boundary layer. This mechanism of "natural transition" was then compared to the transition induced by a transverse wire or thread attached to the plate, normal to the flow. Author

N68-14076*# National Bureau of Standards, Boulder, Colo.
CAVITATION INCEPTION IN LIQUID NITROGEN AND LIQUID HYDROGEN FLOWING IN A VENTURI Interim Report, 15 Jul. 1964–15 Jul. 1967
D. K. Edmonds, J. Hord, and D. R. Millhiser Aug. 1967 55 p refs
(NASA Order C-35560-A)
(NASA-CR-72285; NBS-9293) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Cavitation characteristics of liquid hydrogen and liquid nitrogen in a transparent plastic venturi have been determined. The experimental data are presented in tabular and graphical form. Conventional cavitation-parameter and head-velocity curves are given over the range of experimental temperatures (36.5 to 41°R for hydrogen and 140 to 170°R for nitrogen) and inlet velocities (70 to 185 ft/sec for hydrogen and 20 to 70 ft/sec for nitrogen). Minimum local wall pressure was calculated to be less than bulk stream vapor pressure by as much as 323 feet of hydrogen head and 63 feet of nitrogen head. Author

N68-14080 United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering and Process Technology Div.
APPROXIMATE EQUATIONS FOR THE DIFFUSION AND FLOW OF GASES IN POROUS MEDIA
G. F. Hewitt Aug. 1967 29 p refs
(AERE-R-5492) HMSO: 4s

Approximate equations are developed for the flow of gases under an overall pressure gradient in a straight capillary and the application of these equations to porous media is discussed. Preliminary results show encouraging agreement with the predicted values. Author

N68-14107# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
THEORIES OF THE TURBULENT BOUNDARY LAYERS
D. B. Spalding Jun. 1967 21 p refs
(TWF/TN/27)

Marching, cross-stream, and parametric integration procedures for solving partial differential equations used for solving and predicting turbulent boundary layer problems, are discussed. Explicit integral procedures, combinations of integral methods, the shape factor, and effective-viscosity considerations, are also discussed. L.S.

N68-14278 Union Carbide Nuclear Co., Oak Ridge, Tenn. Gaseous Diffusion Plant
THE PROBLEM OF KNUDSEN FLOW. PART 6: TORTUOSITY
W. C. de Marcus and H. B. Jenkins, Jr. 30 Sep. 1957 11 p ref
(K-1302, Pt. 6)

A simple system with periodic turns has been investigated and numerical results for the transmission probabilities have been obtained for the two cases of diffuse reflection and a small percentage of specular reflection. The results are presented in the form of numerical values for the tortuosity shape factor. Author

N68-14344# Sandia Corp., Livermore, Calif.
ANALYSIS OF SHOCK-FRONT IRREGULARITIES IN THE COLD-GAS SHOCK TUBE WITH SULFUR HEXAFLUORIDE AS THE DRIVEN GAS
M. R. Posehn Oct. 1967 52 p
(Contract AT(29-1)-789)
(SCL-DR-67-88) CFSTI: HC $3.00/MF $0.65

Results of a series of tests in a cold-gas shock tube using sulfur hexafluoride as the driven gas are described. These tests showed that air contamination levels up to five percent by volume and decomposition of the gas at temperatures below 1200°F have little influence on the formation of the shock front. Irregular shock fronts formed, when the initial pressure of the sulfur hexafluoride was greater than one psia. The irregularities were attributed to transverse waves and perturbations caused by the bursting of the diaphragm. An analysis carried out concurrently with the tests showed that transverse waves and perturbations are attenuated more rapidly when the initial pressure of the sulfur hexafluoride is low. Another analysis indicates a similar effect when the acoustic impedance ratio across the contract surface is less than unity. Author (NSA)

N68-14354# Ballistic Research Labs., Aberdeen Proving Ground, Md. Computing Lab.
MULTI PARAMETER COMPUTATION OF THE REFRACTION INDEX WITHIN A BLAST BUBBLE
Aivars K. R. Celmins Sep. 1967 58 p refs
(BRL-MR-1869; AD-662194)

The deformation method for observations of shock phenomena is based on measurements of deformations of images caused by refraction of light within the flow. From such observations the density within the flow can be computed. In case of a blast bubble in air the evaluation of deformation measurements requires the solution of an integral equation. The report describes a numerical solution which is based on a least squares approximation to the (partly correlated) observations. A high flexibility of the evaluation technique is achieved by using a non-linear multi-parameter function for describing the refraction index profile. The report includes a description of a corresponding computer program. Author (TAB)

N68-14572# National Aeronautical Establishment, Ottawa (Ontario). High Speed Aerodynamics Section.
THREE-DIMENSIONAL LAMINAR BOUNDARY-LAYER SEPARATION ON A FLAT PLATE DUE TO A FLOW CONFRONTATION WITH A HALF CONE AT INCIDENCE
P. S. Shen and D. J. Jones Jun. 1967 37 p refs
(LR-485; NRC-9847)

The incompressible, three-dimensional, laminar boundary layer flow on a flat plate about a half-cone protuberance has been investigated both by experiment in water tunnel and by analysis using Cooke's small cross-flow momentum integral method. Three half cones of semi-apex angles 71/2°, 10° and 12-1/2°, were tested at a Reynolds number of 2×10^4 based on plate chord. Reasonable agreement between computed and measured limiting surface streamlines and primary separation lines was found, but the inclusion of the thickness effect of the half cone in the potential model of the external flow was found to be important. Author

N68-14626# Illinois Univ., Urbana. Dept. of Chemistry and Chemical Engineering.

WALL SHEAR STRESS DISTRIBUTION FOR FLOW AROUND A CIRCULAR CYLINDER AT REYNOLDS NUMBER BETWEEN 60 AND 340

Haralambo G. Dimopulos and Thomas J. Hanratty Oct. 1967 128 p refs Sponsored in part by Am. Chem. Soc.
(Grant AF-AFOSR-547)
(Rept.-2; AFOSR-67-2355; AD-662015)

Although the problem of calculating the shear stress distribution around a cylinder has received considerable attention, no direct measurements have been reported. One of the reasons for this is that instruments for measuring the shear stress are limited because of the difficulties involved in their calibration or because of the relatively large size of the transducer. A new electrochemical method which does not have these shortcomings was used to study the flow around a circular cylinder over the reynolds number of 60–340. These allowed a direct examination of the validity of the boundary layer theory and of some aspects of the flow in the wake. The calculations based on boundary layer are found to be valid for re > 150. The measurements in the neighborhood of the front stagnation point are found to depart much more abruptly from the solution for re approaching infinity than is indicated by calculations of Van Kyke for stagnation flow at a parabolic cylinder. The wall shear stresses in the wake regions are quite small. With the exception of the region in the vicinity of the rearwardmost point of the cylinder there is a small but a definite effect of the Reynolds number of the shear stress. Author (TAB)

N68-14641*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECTS OF WALL PRESSURE DISTRIBUTION AND LIQUID TEMPERATURE ON INCIPIENT CAVITATION OF FREON-114 AND WATER IN VENTURI FLOW

Royce D. Moore, Robert S. Ruggeri, and Thomas F. Gelder Washington Jan. 1968 25 p refs
(NASA-TN-D-4340) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Incipient cavitation of Freon-114 (dichlorotetrafluoroethane) and of water was studied over a range of liquid temperatures in three different transparent venturis mounted in a small hydrodynamic tunnel. Flow velocity in the approach section of the venturis was varied from 18 to 65 feet per second (5.5 to 19.8 m/sec). The venturis were designed to provide systematic changes in wall pressure distribution. Circular arcs of differing radii provided transition from a 1.745-inch- (4.432-cm-) diameter approach section to a 1.375-inch- (3.492-cm-) diameter throat section. For Freon-114, the magnitude of thermodynamic effects of cavitation was significantly reduced for the milder pressure distributions and increased with liquid temperature. No thermodynamic effects of cavitation were observed for water over the temperature range studied. For both water and Freon-114, the incipient cavitation parameter was always less than the noncavitating minimum pressure coefficient, which indicated that the liquids locally experienced effective liquid tensions at the incipient condition. The magnitude of these tensions was strongly dependent on the wall pressure distribution and decreased with the milder pressure distribution. Author

N68-14731* Lockheed Missiles and Space Co., Sunnyvale, Calif.

FLOW SEPARATION STUDIES

Rolf A. Guenther Dec. 1966 46 p refs
(Contract NAS8-20354)
(NASA-CR-61433; LMSC-L-87-66-1) CFSTI: $3.00 CSCL 20D

The separation phenomenon is the result of a momentum-deficient boundary layer encountering an adverse pressure gradient it is unable to negotiate. Separation immediately produces a physical system in which the losses of momentum due to the shear stresses at the wall are considerably reduced, and the momentum of the detached shear layer is increased by the more vigorous mixing of the boundary layer with the external "inviscid" stream. Separation is common to both subsonic and supersonic flows, occurring subsonically due to the geometry, and supersonically due to geometry and interactions between shock waves and boundary layers. This paper attempts to summarize the main theories of separation with emphasis on corner-induced separation. A number of unsteady techniques are referenced to help the reader devise a method which could include the unsteady separated flow regime. Author

N68-14759 United Kindgom Atomic Energy Authority, Harwell (England). Information Branch.

EXPERIMENTAL STUDY OF THE HYDRODYNAMICS OF TWO-PHASE FLOWS IN VERTICAL PIPES

G. G. Bartolomei and R. Georgescu Feb. 1967 21 p refs Transl. into ENGLISH from IEA (Bucharest), Rept. TR-52, 1966
(AERE-TRANS-1076; TR-52) HMSO: 3s

The hydrodynamics of a steam and water mixture were examined at relatively low superficial velocities in vertical heated and unheated pipes in order to determine the flow structure. Tests were conducted on the same equipment, at identical circulation velocities, with the same range of pressures, and were analyzed using the same relation so that the data would be comparable. Experimental data were obtained at pressures of 15, 25, and 35 bar in both heated and unheated pipes. It was found that the void fraction increases with increasing heat flux and decreasing pressure. The slip ratio between the true velocity of liquid and the true velocity of steam is shown to depend primarily on the circulation rate. The boundaries of bubble, plug, and annular flow were determined without heating. As the pressure and superficial velocity of steam increase, the region of plug flow conditions becomes smaller and the regions of bubble and annular conditions increase. In tests with heating, bubble conditions are the main conditions of motion of the steam and water mixture in the range of parameters investigated and plug flow conditions are absent. E.J.S.

N68-14877* Techtran Corp., Glen Burnie, Md.

FLOW FORMATION NEAR THE MODEL IN A SHOCK TUBE [FORMIROVANIYE TECHENIYA OKOLO MODELI V UDARNOY TRUBE]

M. P. Syshchikova, M. K. Berezkina, and A. N. Semenov Washington NASA Dec. 1967 23 p refs Transl. into ENGLISH from the book "Aerofizicheskiye Issledovaniya Sverkhzvukovykh Techenii" Moscow, Nauka, 1967 p 7–13
(Contract NASw-1695)
(NASA-TT-F-11431) CFSTI: $3.00 CSCL 01A

The results are presented from an experimental investigation of the flow process near a blunt body, including the formation of a bow shock wave, development of boundary layer flow and flow processes in the wake. Time characteristics of such geometric flow parameters as separation of the shock wave, shape of the shock wave and radius of shock wave curvature are obtained. A plane body, a circular cylinder, and a sphere are the forms of blunt bodies considered. Simple shadow and schlieren photographic methods are used. Author

N68-14899 Commissariat a l'Energie Atomique, Paris (France).

THEORY OF THE EXPLOSION OF REVOLUTION AND PERMANENCE [THEORIE DE L'EXPLOSION DE REVOLUTION ET PERMANENTE]

R. Charet 15 Sep. 1967 7 p refs In FRENCH Presented at High Dyn. Pressure, Paris, 11–15 Sep. 1967

Explosive waves in a revolving cylinder are discussed and conditions of internal coherence within the model and of

conservation are considered. Confinement along the axes is evaluated. A model is proposed for conditions that are quasi-ideal, and properties of this model and the role of environment are described. Symmetry and permanence of the detonation are considered. Transl. by MWR.

N68-14964# Alabama Univ. Research Inst., Huntsville.
NUMERICAL ANALYSIS OF A METHOD FOR CALCULATING THREE-DIMENSIONAL SUPERSONIC FLOW FIELDS Final Technical Report
Jerome J. Brainerd Aug. 1967 102 p refs
(Contract DA-01-021-AMC-11901(Z))
(RR-44; AD-662775)

The stability and error of a method of near-characteristics computer program are studied. A scheme for almost second-order integration of the equations and a rapidly convergent shock calculation method are proposed. In addition, a technique to insure automatic fulfillment of the CFL condition is described. Author (TAB)

N68-14980 Adviesbureau der Genie, The Hague (Netherlands).
THE ANALYSIS OF SOME TWO-DIMENSIONAL POTENTIAL FLOWS TO BE USED AT THE STUDY OF PROBLEMS OF OIL-MIGRATION
R. W. Trense Jul. 1967 33 p
(NR-168; TDCK-49275.2)

A mathematical discussion is presented for migration flows through porous, isotropic, and anisotropic media. Expressions are presented for boundary flow and progression curves, and reflections of the pollution stream against the capillary ground water surface are considered. N.E.N.

N68-14997# France. Ministere de l'Air, Paris.
CONTRIBUTION TO THE STUDY OF TURBULENT FLOW IN A POROUS CYLINDRICAL CONDUCTOR WITH SUCTION [CONTRIBUTION A L'ETUDE DE L'ECOULEMENT TURBULENT DANS UNE CONDUITE CYLINDRIQUE POREUSE AVEC ASPIRATION]
Roger Aureille Serv. de Doc. Sci. et Tech. de l'Armament 1967 86 p refs In FRENCH *Its* No. 433
CFSTI: $3.00

The effect of uniform wall suction on the turbulent flow developed in a porous cylindrical tube was studied to determine the output of air at different suction rates. Distribution of longitudinal speed as a function of radius was measured in four different sections of the porous model by means of pressure probes. Static pressure probes resulted in determining the static pressure along the longitudinal axis of the flow. The friction coefficient and the radial distribution of Reynolds tensions were determined. Transl. by M.W.R.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-13907# Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
MAGNETIC MEAN HOURLY VALUES FROM WATHEROO OBSERVATORY, WESTERN AUSTRALIA 1953–1954
P. M. McGregor 1966 124 p refs
(Rept.-112)

Tabulated hourly and monthly mean values of the magnetic elements, and daily Fourier coefficients, derived from normal magnetograms produced at Watheroo Observatory in 1953 and 1954 are presented. It also includes a list of annual mean values 1919–1954. Author

N68-13915 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, ABSORPTION-MEASUREMENT: FREIBURG, URSI-CODE 131, JULY–SEPTEMBER 1967 [IONOSPHAEREN-DATEN, ABSORPTIONS-MESSUNGEN: FREIBURG, URSI-CODE 131, JULI–SEPTEMBER 1967]
1967 8 p refs In GERMAN

Automatic ionospheric echo absorption measurements are presented for the period July through September, 1967. Values are obtained at eight different frequencies and are evaluated for their monthly medium. Transl. by G.G.

N68-13951# Hermanus Magnetic Observatory (South Africa). Geophysical Branch.
MAGNETIC OBSERVATIONS AT HERMANUS IN 1966
1966 51 p *Its* Geophys. Ser. 1
(A.15)

Tables are presented on the mean annual values (1941–1946), the adopted base line and scale values of magnetograms, the mean hourly values of declination (horizontal intensity and vertical intensity), and mean monthly and annual values of the magnetic elements. The diurnal variations of D, H, Z, X, and Y are listed. A bibliography of publications is included. M.G.J.

N68-13963 Danish Meteorological Inst., Charlottenlund.
THE ICE-CONDITIONS IN THE GREENLAND WATERS, 1958
1967 81 p refs

A series of charts is presented to show Arctic ice conditions existing on certain days in each month of 1958. The information is based primarily on data gathered from United States and Canadian ice reconnaissance flights, supplemented when necessary by ship observations. The explanatory text assesses the observations on the polar ice, and the extent of ice formations on the east and west coasts and along the coast stations. M.G.J.

N68-13993# Lightning and Transients Research Inst., Minneapolis, Minn.
EXPERIMENTAL STUDY OF TRIGGERED NATURAL LIGHTNING DISCHARGES Final Report
M. M. Newman, J. R. Stahmann, and J. D. Robb Mar. 1967 62 p refs
(Contract FA-66-NF-166)
(FAA-ADS-67-3; AD-661827)

Studies of the natural lightning discharge channel have been continued in the Summer of 1966 using a triggering technique during which 17 strokes were triggered out of 23 attempts. The discharges were triggered by firing a rocket carrying a fine wire to an altitude of about 400 meters when electric field meters indicated a discharge was probable. The studies showed clearly in the Fastax photographs, the current oscillograms, and in the still photographs the existence of a low current continuing component lasting up to 0.8 seconds following nearly every initial high current stroke. Also, high current restrikes were found after nearly every

stroke with as many as a dozen restrikes in a single lightning discharge. Blast pressure measurements showed higher peak pressures than measured previously from triggered natural lightning discharges and also longer durations. This is of interest in relation to possible structural damage to aircraft and also in relation to shock wave effects on flame propagation in aircraft fuel vents. High speed motion pictures of the discharge clearly showed the violent snake like motion of the channel of importance in evaluation of stroke sweeping effects near aircraft. Author (TAB)

N68-14023# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany). Inst. fuer Stratosphaerenphysik.
RECORDING OF PULSATIONS IN SOUTHERN LOWER SAXONY AS A CONTRIBUTION TO GEOMAGNETIC DEPTH SOUNDING [REGISTRIERUNG VON PULSATIONEN IM SUEDLICHEN NIEDERSACHSEN ALS BEITRAG ZUR ERDMAGNETISCHEN TIEFENSONDIERUNG]
Rudolf Jaeschke 1963 39 p refs In GERMAN
(Rept.-12/1963) CFSTI: HC $3.00/MF $0.65

Geomagnetic depth sounding aims at determining the distribution of subterrestrial electrical conductivity by means of natural earth currents induced electromagnetically through geomagnetic variations. As a follow-up to the investigation of the North German conductivity anomaly made by Schmucker in 1957/59, geomagnetic depth soundings were taken on a profile between Göttingen and Brunswick during the period April–June 1962. Four identical 3-component stations (two of them mobile, and two permanently installed at Göttingen and Wingst) were used, the recording of the pulsations being made with the aid of Grenet-type variometers. The results of an exploitation of the recordings of 'pulsation train'-type disturbances are given, followed by suggestions regarding more extensive future investigations. ESRO

N68-14045# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany). Inst. fuer Stratosphaerenphysik.
THE RELATIONSHIP OF GEOMAGNETIC PULSATIONS TO LATITUDE [ZUR BREITENABHAENGIGKEIT ERDMAGNETISCHER PULSATIONEN]
Hans Voelker 1963 55 p refs In GERMAN
(Rept.-11/1963) CFSTI: HC $3.00/MF $0.65

The aim of the work was to examine the behavior of pulsations in the magnetic field recorded simultaneously at separately-located observation stations, thereby establishing whether the pulsation pattern is uniform or varies with location. In particular, an answer was sought to the hitherto disputed question of whether or not pulsation periods have a dependent relationship to geomagnetic latitude. An improved apparatus (based on the Grenet method) for recording H, D and Z component pulsations was developed, enabling recordings made at three different stations—Wingst, Göttingen and Fürstenfeldbruck—to be compared directly. The presence and behavior of particular effects was found to vary according to the time of day, and whereas the pattern of some effects was more or less uniform at all locations, other effects varied according to the latitude of the observation station. Author (ESRO)

N68-14068# Paris Univ. (France). Faculte des Sciences.
ON THE DIURNAL MAGNETIC ACTIVITY IN THE POLAR CAPS [SUR L'ACTIVITE MAGNETIQUE DIURNE DANS LES CALOTTES POLAIRES]
Andrew Lebeau (M.S. Thesis—Groupe de Rech. Ionospheriques) Centre Natl. de la Rech. Sci. 24 Jul. 1965 58 p refs In FRENCH; ENGLISH summary
CFSTI: HC $3.00/MF $0.65

It is interpreted through a model in which the diurnal activity intensity is determined by the combined action of two separate factors, an 'excitation' factor which tends to create a maximum at magnetic noon and a modulation factor, controlled by the local time, and identified with the effect of the E region conductivity. Geographical repartition and seasonal variation of the amplitude of the activity are interpreted by means of this model. The excitation factor geometry is then specified. The action of this factor is shown to be maximum on a closed ring surrounding the invariant pole and shifted towards high latitudes in the daylight side of the earth. This ring and the upper latitude limit of the trapping zone coincide and correspond to a maximum in the intensity of electron precipitations. Finally, it is shown that the diurnal variation of the field derived from hourly mean values and magnetic activity measured by the daytime maximum amplitude are locally proportional. A study of daytime perturbations in the ionograms obtained at Dumont d'Urville brings some further elements which fit into the general scheme. Author (ESRO)

N68-14072# California Univ., Livermore. Lawrence Radiation Lab.
THEORETICAL MODEL OF THE AXIAL CURRENT AND MAGNETIC FIELD DISTRIBUTION OF THE E-LAYER: COMPARING WITH EXPERIMENTAL RESULTS
N. C. Christofilos 5 Jul. 1967 9 p refs
(Contract W-7405-ENG-48)
(UCID-15230) CFSTI: HC $3.00/MF $0.65

Calculations were made of the E layer axial current and magnetic field distribution. NSA

N68-14083 Joint Publications Research Service, Washington, D. C.
WATER MASSES OF THE SEA OF OKHOTSK
K. V. Moroshkin 10 Jan. 1968 100 p refs Transl. into ENGLISH of the book "Vodnyye Massy Okhotskogo Morya" Moscow, Nauka Publishing House, 1966 p 1–66
(JPRS-43942) CFSTI: $3.00

A detailed description is presented for the ocean currents and the physical characteristics of the Sea of Okhotsk. Currents on the surface and in deep waters are discussed. Temperature distribution and salinity data are graphed, and seasonal variations are reviewed. The properties by which the water masses are distinguished are outlined. N.E.N.

N68-14108* Allied Research Associates, Inc., Concord, Mass.
PROCESSING OF SATELLITE INFRARED DATA FOR SEA SURFACE TEMPERATURE DETERMINATION Final Report
James R. Greaves and James H. Willand Jan. 1967 117 p refs
(Contract NASw-1157)
(NASA-CR-91732; Rept.-9G16-F) CFSTI: $3.00 CSCL 08C

Mass data processing techniques are applied to the general problem of sea surface temperature (and temperature gradient) determinations using satellite infrared data. The work discussed includes: 1) modification and development of special-purpose computer programs to list and map sea surface temperature data for clear sky areas, 2) development of a computer program to produce composite sea surface temperature maps from two or more separate passes, 3) application of these programs to three ocean areas, to experiment with optimal data averaging and processing techniques and to study oceanographic phenomena, and 4) the preparation of recommendations and suggestions regarding larger scale investigations or routine operational satellite measurements of sea surface temperatures. The computer programs and processing techniques were successfully applied to three ocean areas where

warm and cold ocean currents were clearly depicted, as was cold water upwelling along the western coast of South America. Author

N68-14168# Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia). Dept. of National Development.
GEOLOGICAL INVESTIGATIONS ALONG THE ANTARCTIC COAST BETWEEN LONGITUDES 108° E AND 166° E
I. R. Mc Leod and C. M. Gregory 1967 60 p refs Its ANARE Rept. Ser. No. 83
(Rept.-78)

Results are described of geological work along the Antarctic coastline between 108°E. and 166°E. during relief voyages by the Australian National Antarctic Research Expeditions in the early months of 1959, 1960, 1961, and 1962. The predominant rock type is fine-grained banded, or medium-grained quartz-biotite-feldspar, gneiss. Quartzo-feldspathic veins of several kinds are common in parts of the gneisses. The mineralogical composition of the gneisses indicates derivation from sediments by high-grade regional metamorphism. Low-grade metamorphic rocks, originally pelitic sediments by high-grade regional metamorphism. Low-grade metamorphic rocks, originally pelitic sediments, were found near Cape North and Zykov Glacier. Those near Zykov Glacier show evidence of a period of thermal crystallization, which could have been either a concluding phase of the regional metamorphism or a separate later episode associated with the emplacement of granitoid rocks. Massive granitoid rocks were found near Cape North, on Sputnik Island, Penguin Point, and at southern Vincennes Bay. Trachyte and red and purple indurated sandstone were found in moraine, principally in the Vincennes Bay region. Author

N68-14327# Instituto Geografico y Castastral, Madrid (Spain).
CRUSTAL STRUCTURE OF THE MEDITERRANEAN SEA. PART 2: PHASE VELOCITY AND TRAVEL TIMES
G. Payo Aug. 1967 37 p refs
(Contract AF 61(052)-657; Proj. Vela-Uniform)
(AFOSR-67-2415; SR-22; AD-662628)

Crust-mantle structure of the Mediterranean sea is studied by phase velocity of Love and Rayleigh waves and by body waves travel time. Two distinct regions are found; a Western Zone between Italy and Spain of oceanic type (crustal thickness about 13 km) not showing low velocity channel in the Upper Mantle, and an Eastern Zone to the South of Greece (crustal thickness about 23 km) with a very thick sedimentary layer. Author (TAB)

N68-14332# Shell Development Co., Houston, Tex. Exploration and Production Research Div.
THE MECHANICAL ANALYSIS OF QUARTERNARY TECTONISM Final Scientific Report, 1 Oct. 1966–30 Sep. 1967
John H. Howard 31 Oct. 1967 126 p refs
(Contract F19628-67-C-0036)
(AFCRL-67-0630; AD-662635)

The research is concerned principally with the analysis of strains which have developed at the earths surface during the last 35 years. The report consists of five parts: (1) A summary of objectives and accomplishments and a statement of possible, future, continued research on recent earth-strains; (2) an article explaining the method developed for the analysis of strain when limited data are available on the movements of points within the deformed body; (3) an article devoted to the analysis of strains at Buena Vista Hills, California, during 1932-1959; (4) an article on the analysis of strains during 1932-1966 at two areas which cross the San Andreas Fault in California, the Cholame area and the Taft-Maricopa area; (5) an article demonstrating the applicability of the method to other problems in the analysis of strain, in this case, to the analysis of deformed fossils. Deformation of the earths surface has occurred within the last 35 years and presumably is continuing today. The deformation is documented by repeated surveys of geodetic movements. Sufficient data exist at a number of areas (for example, Buena Vista Hills, Cholame, and Taft-Maricopa, California) to determine strains. These determinations, however, involve interpolations of data. Estimated principal strains range from +300 x 10 to the -6th power to -5000 x 10 to the -6th power. The estimated rate of change of dilatation for the San Andreas fault zone at Cholame, is as high as 11 x 10 per year (for 1962-1966). Inadequate data prevented a reasonable projection of strains to the moment of the Cholame 1966 earthquake. Author (TAB)

N68-14347# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF AEROMETHODS FOR INVESTIGATION OF THE OCEAN
V. G. Zdanovich, I. V. Semenchenko et al 7 Apr. 1967 675 p refs Transl. into ENGLISH of the book "Primeneniye Aerometodov Dlya Issledovaniya Morya" Moscow, Izd. An. Nauk SSSR, 1963 p 1-646
(FTD-MT-64-347; AD-662577)

The book illuminates the application of aerial techniques in oceanologic and hydrographic investigations. Questions of aerial photography of the sea and the aerial survey process are examined and the existing aeromethods for studying ocean waves and currents and for determining the depths and mapping of ocean shallows are considered in detail. Electronic equipment and the methods of its application for measurement of spectral brightness of the sea from an aircraft are described. The publication is intended for photogrammetrists, hydrographers, and oceanologists occupied in the development and application of aeromethods for investigation of the oceans. The authors have generalized the results of works on the development and application of aeromethods in investigations of the ocean carried out mainly in the Laboratory of Aeromethods of the Academy of Sciences of the USSR. This latter circumstance has, to a considerable degree, determined the content and structure of the monograph, which therefore embraces only a part of the problems related to the considered region. Basic attention in the book is allotted to the methodology of studying ocean waves and currents, determining depth, charting shoal water, and measuring the spectral brightness of the sea. Author (TAB)

N68-14401# Ionospharen-Institut Breisach (West Germany).
DIRECT OBSERVATIONS OF ELECTRON DENSITY IN THE IONOSPHERE [DIREKTE BEOBACHTUNGEN DER ELEKTRONENDICHTE IN DER IONOSPHAERE]
Karl Rawer [1967] 14 p In GERMAN; ENGLISH summary

The classical method of sounding the ionosphere by impulses does not enable the electronic density to be ascertained at any given altitude. It is thus worth-while to obtain additional information by means of direct tests. Three tests with rockets are here described. The radio spectrometer is a receiver adjusted to an electronically variable frequency enabling a study to be made of the variations in field of the radio-to-ground transmitters as a function of the altitude. The effect of wave diffraction around the earth is observed and, lastly, the often brutal attenuation in the D-layer. For an antenna surrounded by plasma, a resonance effect appears on a calculated frequency depending on the electronic density and the vector of the Earth's magnetic field. The direction of this latter in relation to the axis of the antenna plays a role. This method has been used to ascertain the profile of the "valley", i.e. of the minimum of electronic density found between the E and F regions. In conclusion, a final method is described for determining the electronic content, namely the integrated value of the electronic

density between a ground transmitter and a receiver on board the rocket, two harmonic frequencies being transmitted and being received on board. A pulsation is obtained which corresponds to the difference of the Doppler effects on the two frequencies. By this method, the kinematic effect is eliminated; there remains only the effect of the plasma. The method is highly sensitive and makes it possible to determine profiles not detected by the method of sounding with apparatus on the ground. Author

N68-14441# California Univ., Berkeley. Radio Astronomy Lab.
STUDY OF ATMOSPHERIC CONSTITUENTS AND STRUCTURE BY MEASUREMENT OF TRANSMISSION AND ABSORPTION OF MILLIMETER WAVES OF RADIOASTRONOMICAL ORGIN Final Report, 24 Feb. 1966–31 Aug. 1967
William J. Welch Sep. 1967 24 p refs
(Contract AF 19(628)-5884)
(AFCRL-67-0548; AD-662365)

It has been proposed that the vertical temperature structure of the troposphere may be measured by observing the emission from the wing of the 5mm band of atmospheric oxygen. The present study was initiated in an attempt to discover whether such a procedure is indeed practical. A radiometer which can be tuned over the range 50 - 60 MHz has been constructed and tested. The radiometer is at present capable of measuring the zenith sky brightness at between 4 and 6 wavelengths in one hour with a precision of about 0.3K at each wavelength. A computer program has been developed for predicting the zenith brightness temperature and for ultimately inverting the measurements to obtain the atmospheric temperature profile. Replacing the Fredholm integral equation by an approximate set of algebraic equations is known to be an unstable procedure, and it is found that measurement precision of the order of 0.1K is required for that technique to work at all. It is noted that a technique such as that suggested by Westwater (1965) will probably work with the measurement precision that is available with the present instrument. Author (TAB)

N68-14475# European Atomic Energy Community, Brussels (Belgium).
RESULTS OF ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS IN THE COMMUNITY COUNTRIES IN 1966: AIR, FALLOUT, WATER [RESULTATS DES MESURES DE LA RADIOACTIVITE AMBIANTE DANS LES PAYS DE LA COMMUNAUTE EN 1966: AIR, RETOMBEES, EAUX]
Nov. 1967 72 p In GERMAN, FRENCH, ITALIAN, and DUTCH; ENGLISH summary
(EUR-3602.D/F/I/N)

This report contains the results of the measurements carried out in 1966 by the member States at the environmental radioactivity monitoring stations, together with certain data obtained at Euratom's Joint Research Centre, Ispra. The report comprises an introductory note and three sections dealing with measurements of radioactivity in the air at ground level, in fallout and in water. Most of these measurements relate to total beta radioactivity. The measurement results for certain specific radionuclides are also given as well as the amount of precipitation observed at fallout sampling stations. Graphs are given to show the pattern followed throughout the year, a comparison being drawn with the development over the years 1962, 1963, 1964 and 1965 as well as with the situation in 1966 in the United States and Canada. Author

N68-14486# Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany).
DIFFERENTIAL DOPPLER SYSTEM FOR MAGNETOSPHERIC AND INTERPLANETARY ELECTRON DENSITY MEASUREMENTS [DIFFERENTIELLES DOPPLERVERFAHREN FUER MAGNETOSPHAERISCHE UND INTERPLANETARE ELEKTRONENDICHTE-MESSUNGEN]
H. H. Rabben Jun. 1966 33 p refs In GERMAN
(MPI-PAE-Extraterr.-31/66) CFSTI: HC $3.00/MF $0.65

Following the successful ionospheric electron density measurements by Seddon (1953) using the differential Doppler system the suitability of this relatively simple technical process is discussed for both the magnetosphere and the interplanetary medium. This process is compared with the proposed wave propagation method for direct determination of the plasma frequency. The choice of method depends on the marginal conditions of the measurements. Author (NSA)

N68-14546# Stanford Research Inst., Menlo Park, Calif.
MEASUREMENTS OF EQUATORIAL MAGNETIC DIP ANGLE AT IONOSPHERIC HEIGHTS
Vichai T. Nimit May 1967 64 p refs *Its* Spec. Tech. Rept.-33
(Contract DA-36-039-AMC-00040(E); ARPA Order 371)
(AD-662064)

Data collected for calculating electron content of the ionosphere by the Faraday rotation technique can be used to calculate the magnetic dip angle at ionospheric height near the geomagnetic dip equator. In this report the magnetic dip angle at ionospheric height was determined at the position where the angle between the ray path from the satellite to the ground station and the geomagnetic field vector is 90 degrees (transverse position). The magnetic dip angle calculation was based on the assumption of a constant height of 350 km for the centroid of the ionospheric electron-density profile. The spherical harmonic analysis is used to verify the experimental results. The results compare well with the surface magnetic dip angle, measured in 1956-1960 by the Geodesy Department of the Ministry of Defense, Thailand, and indicate that the magnetic dip angle at ionospheric height is very close to the surface value. These data permit estimation of the position of the geomagnetic dip equator at the ionospheric height. The estimated position of this equator is directly above the geographic latitude of 9.30 degrees N. This latitude intersects the southern peninsula of Thailand about 480 km south of Bangkok (near Surat Thani). This estimated value compares well with the surface geomagnetic dip equator and indicates that the dipole field is a good model for Southeast Asia in the vicinity of longitude 100 degrees E. Author (TAB)

N68-14637*# Rensselaer Polytechnic Inst., Troy, N. Y.
A STUDY OF THE EFFECT OF SURFACES ON OXYGEN ATOM RECOMBINATION AT LOW PRESSURES Technical Status Report No. 1, May 1–Oct. 31, 1967
P. Harteck and R. R. Reeves, Jr. 31 Oct. 1967 5 p
(Grant NGR-33-018-086; RPI Proj. 441-22)
(NASA-CR-91734) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The purpose of this work is to determine the catalytic effect of surfaces on constituents found in the upper regions of the atmosphere in the pressure region of 10^{-5} to 10^{-9} torr. The work is directly related to the problem of satellite experiments involving mass spectrometric measurements in this region where surfaces may alter or react with oxygen and hydrogen atoms. This interim report discusses the experimental techniques and many of the direct and indirect problems involved and the results obtained today. In addition there is the special problem of the high relative velocity of the atmospheric particles (>4ev for O-atoms) which impinge on the satellite at velocities corresponding essentially to the velocity of the satellite. Such highly energetic collisions may produce anomolous results, which are difficult to predict from the results of laboratory experiments. Author

N68-14650# General Atronics Corp., Philadelphia, Pa.
LARGE APERTURE SEISMIC ARRAYS (LASA)
Sep. 1967 78 p refs
(Contract F19628-67-C-0370; ARPA Order 800)
(ESD-TR-67-615; QTR-1; AD-662632)

Four topics are discussed in the report. The first topic related to the high-frequency (4-5 Hz) portion of LASA seismograms. Data are cited which indicate a statistically significant amount of signal energy in this region, and preliminary unsuccessful efforts at combining high-pass filtered records from nearby seismometers are described. The second topic is the problem of detecting underground nuclear tests in the presence of large natural events. A hypothetical detection system consisting of a umber of single seismometers at close range and a continental-size array at teleseismic range is analyzed and discussed. The third topic is DIMUS processing of seismic array out-puts. The conventional DIMUS processing consists of hardlimiting each seismogram (thereby yielding a one bit per sample representation) and then proceeding as with the unaltered seismograms. Two modified DIMUS schemes, which require a single analog channel, are considered. The performance of these schemes, conventional DIMUS, and conventional analog arrays is evaluated for the spectral-ratio and complexity diagnostics. Finally, an extended version of an automatic pP test is discussed. Initial calculations are presented that suggest that this test will yield satisfactory depth picks for earthquakes as deep as 150 km.
Author (TAB)

N68-14669# Woods Hole Oceanographic Institution, Mass.
OCEANOGRAPHIC AND UNDERWATER ACOUSTICS RESEARCH CONDUCTED DURING THE PERIOD 1 NOVEMBER 1966-30 APRIL 1967
Oct. 1967 52 p refs
(Contract Nonr-4029(00))
(REF-67-65; AD-662401)

The report discusses ray representation of diffraction effects, shallow and deep water propagation experiment plans and results, acoustical instrumentation advancements, and ambient noise in arctic waters. In the physical oceanography task unit, sound velocity profiling in the Mediterranean and the area south of Bermuda are discussed, as are the interpretations and equipment developments. The sea floor properties task unit included bottom reflectivity, distribution of sediment ponds, Eastern Mediterranean sea floor structure, rock magnetism, heat flow geomagnetism and gravity reports. Summaries of activities under advisory and shipboard data processing task units are included.
Author (TAB)

N68-14678# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
ACOUSTICAL AND METEOROLOGICAL DATA REPORT SOTRAN 3 AND 4
Robert S. Bonner and Ralph H. Rohwer May 1967 185 p refs
(ECOM-5129; AD-659326)

Meteorological, acoustical, and seismic data acquired from SOTRAN III and IV are presented. The monitoring sites, instrumentation, and field operations are described.
Author (TAB)

N68-14690 National Environmental Satellite Center, Suitland, Md.
SOME APPLICATIONS OF SPACE OBSERVATIONS TO METEOROLOGY, OCEANOGRAPHY AND HYDROLOGY
Vincent J. Oliver 27 Oct. 1967 11 p refs Presented at 4th Ann. Meeting of AIAA, Anaheim, Calif., 23-27 Oct. 1967

The data from both manned and unmanned satellites give us information which when properly used will be of great benefit to all mankind. Meteorologists using data from present operational weather satellites already can guarantee that no major storm can form anywhere on earth without being accurately located on the day of its birth. From new satellites now under construction will come the necessary quantitative measurements needed by the advanced computers which are currently used for weather analysis so that it will be possible not only to detect existing storms by computer, but also to predict storm formation and motion both more accurately and farther in advance. New sensors now being constructed will make it possible to map ocean currents, turbidity, and temperature. Such analyses will be of great economic value to those industries, present and future, which depend on the oceans for their resources. Sensors which measure the radiance from land surfaces will greatly simplify collecting data concerning the earth's surface in our sparsely populated areas. This new data source can be applied to such problems as locust control in deserts, snow field mapping in mountains and ice and snow mapping over inland lakes and rivers.
Author

N68-14706# European Organization for Nuclear Research, Geneva (Switzerland).
USE OF HELICOPTERS FOR MEASUREMENT OF GROUND RADIATION [EINSATZ VON HELIKOPTERN ZUR MESSUNG DER GELAENDEVERSTRAHLUNG]
J. Gut Sep. 1966 20 p refs In GERMAN *Its* ABC Bull. No. 8
(NP-16766)

The use of helicopters for measuring ground radiation following a nuclear explosion is examined. Theoretical consideration is given to the flight height of the helicopter, the effect of the ground surface, and the time required for a helicopter at a given speed to measure radiation over a fixed amount of ground surface. The technical problems associated with the detection equipment and the helicopter are described. A practical method of ground radiation measurement is outlined which uses a helicopter with both a pilot and an operator for the detection equipment. It is concluded that ground radiation measurement by means of helicopters can be fast, precise, and without great expense.
NSA

N68-14781 Hawaii Inst. of Geophysics, Honolulu.
GEOGRAPHIC VARIATION OF SOFAR SPEED AND AXIS DEPTH IN THE PACIFIC
Rockne H. Johnson and Roger A. Norris Apr. 1967 97 p refs
(HIG-67-7)

Contour charts of sofar speed and axis depth are presented for the Pacific Ocean extending from 60°N to 60°S. A meridional section of sound speed is included. Speeds were computed from hydrographic data by Wilson's formula.
Author

N68-14791 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA VERTICAL-ECHO-SOUNDING: FREIBURG, URSI-CODE 131, OCTOBER 1967 [IONOSPHAERENDATEN, VERTIKAL-ECHO-LOTUNG: FREIBURG, URSI-CODE 131, OKTOBER 1967]
Oct. 1967 44 p In GERMAN and ENGLISH
(Rept.-256-F)

Tables are presented of the hourly and daily recordings of the ionospheric sounding data.
N.E.N.

N68-14827 Defense Intelligence Agency, Washington, D. C.
VALIDATION OF REQUIREMENTS AND DEVELOPMENT OF CARTOGRAPHIC PRODUCTS FOR MILITARY FORCES
Loren A. Bloom *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 40-48 (See N68-14823 05-21)

Validation procedure guidelines for mapping, charting, and geodetic requirements are defined in terms of the actions necessary to provide evidence that a certain type of data is needed to effectively support the use of weapon systems, operations, or military planning. The correlation of data and its translation into cartographic terms and expressions is discussed, along with the test and evaluation of the prototype which is developed. Project JOG (Joint Operations Graphic) is given as an illustration of the program undertaken to determine the specific type, amount, and manner of portrayal of information required by ground and air users. The common findings between ground and air users are listed, and the resulting savings in production are noted. M.G.J.

N68-14828 Army Map Service, Washington, D. C.
PROCEDURES UTILIZED BY THE ARMY MAP SERVICE IN CONDUCTING MILITARY MAP EVALUATION SURVEYS
Anthony Sorrentino *In* Human Factors Res., Inc. Aeron. Charts and Map Display Aug. 1967 p 49–52 (See N68-14823 05-21)

The organizational structure of the Army Map Service is outlined in terms of the cooperation existing between the various branches of the Armed Services, including direct contact with the military user and observations of maneuver exercises. The methods used in conducting surveys to determine the requirements data are discussed, along with the data evaluation techniques used. Mention is made of the civilian–military team concept which is considered to be a major contribution in achieving user-oriented requirement efforts. M.G.J.

N68-14829 Aeronautical Chart and Information Center, St. Louis, Mo.
DESIGN AND PRODUCTION OF GRAPHICS FOR AIRCRAFT DISPLAY SYSTEMS
Robert H. Sicking *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 53–62 (See N68-14823 05-21)

The production of an aeronautical chart is discussed briefly in terms of the design and development, cartographic research, data compilation, and final copy preparation and reproduction. The need for early and direct contact between the user and the system designer, and allocation of a reasonable time to perform an in-depth study of the operational requirements are stressed. Design limitations are noted, and design potentialities are considered. Miniaturized display graphics are discussed, using the F-106 tactical situation display system as an example. In this system the graphics are reproduced as individual frames on a 35 mm film strip in positive form, that is black lines against a white background. Standards developed for producing miniaturized graphics on high contrast, black and white 35 mm film are delineated, and the problems encountered in developing miniaturized, full color chart graphics are reviewed. M.G.J.

N68-14830 Army Map Service, Washington, D. C.
DESIGN AND COLOR IN CARTOGRAPHY
Thomas R. Yanosky *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 63–68 ref (See N68-14823 05-21)

The development of graphic arts is traced, and some aspects of color and color terminology are considered. The complexities involved in large and medium scale maps are noted, the quality and quantity of the typography used on the maps are discussed, and the symbology used is categorized according to point, line, and area symbols. The recommendation is made that mapping and charting agencies intitiate a concerted program to further enhance the design concepts in graphic presentation, and to develop a keener insight into the psychological aspects of visual perception with emphasis placed on design, color communication, typography, and printing techniques. M.G.J.

N68-14831 Naval Oceanographic Office, Washington, D. C. Lithographic Div.
CAN THE GRAPHIC ARTS ADEQUATELY SUPPORT THE VISUAL PRESENTATION NEEDS OF NAVIGATIONAL SYSTEMS?
Deforest D. Choha *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 69–74 (See N68-14823 05-21)

Cockpit display requirements are explored to illustrate the inadequacies that exist in supporting the graphic needs of different types of visual navigational cockpit display systems. Consideration is given to three groups: faster scan conversions (electronic transmission), direct view (roller map), and optical display. The characteristics of optical projection displays are defined, and the point is made that such systems should be designed to make direct use of existing standard aeronautical chart and topographic map series in some form. Definition, color, resolution, and density criteria are assessed in terms of existing technologies. A strong recommendation is made for a team approach to a systems analysis which would encompass the entire spectrum of the graphic arts, printing, photography, optics, and the imaging sciences and arts. M.G.J.

N68-14844 Defense Intelligence Agency, Washington, D. C.
CURRENT RESEARCH AND DEVELOPMENT TRENDS IN MAPPING, CHARTING, AND GEODESY
Charles W. Schlager *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 150–154 (See N68-14823 05-21)

The DOD organizational structure for insuring that new equipment and techniques are available to satisfy military requirements for mapping, charting, and geodesy is described. Research and development budgetary trends are reviewed, and the impact of military strategy changes on the types of services provided are discussed. Individual problem areas are considered, and the overall trends in these areas are identified as the necessity for more precise measurements, faster response time, higher quality products, and increased volume of products. Budget and manpower limitations are recognized. M.G.J.

N68-14845 Army Map Service, Washington, D. C.
THE CONCEPT AND APPLICATION OF DIGITIZED TERRAIN
Perry R. Gilbert *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 155–159 (See N68-14823 05-21)

The preparation of numerical terrain maps is described; the completed product is a 6,000,000 address matrix with a value for Z (height information) for the X–Y intersections. The operational features of the digital graphics recorder are discussed, along with the computer program used to interpolate the data. Possible future uses for numerical maps are assessed, and the need for a firm understanding between the cartographer and the actual user is stressed. The prediction is made that any scale map could be made from basic file data by directing it to a scribing plotter and producing the color-separated scribed material. M.G.J.

N68-14848 Human Factors Research, Inc., Santa Barbara, Calif.
DISCUSSION GROUP 2. THE LOGISTICS OF CARTOGRAPHIC SYSTEMS AND IMPLICATIONS FOR THE DESIGN OF MAP-DISPLAY SYSTEMS Summary Report
In its Aeron. Charts and Map Displays Aug. 1967 p 174–175 (See N68-14823 05-21)

The display–graphic support interface is discussed in relation to roller map displays which use standard paper charts, and optical projection displays which use some form of miniaturized chart graphics. To reduce the requirements placed on operational personnel in joining appropriate sections of the roll strip charts, recommendations are proposed for developing a shipboard or advance-base reproduction capability. Deficiencies in optical projection displays are identified as limitations in the optical lens and photographic color film. An interim solution is proposed whereby an aeronautical chart or color proof would be reduced 10 times on a 105×150 mm film. A shipboard or advance-base capability would also be required to photographically reduce a chart overlay containing pertinent intelligence and mission planning data.
M.G.J.

N68-14849 Human Factors Research, Inc., Santa Barbara, Calif.

DISCUSSION GROUP 3. PROBLEMS IN ACHIEVING VERSATILITY OF, AND CARTOGRAPHIC SUPPORT FOR, DISPLAYS TO BE USED IN DIFFERENT FLIGHT MODES Summary Report

In its Aeron. Charts and Map Displays Aug. 1967 p 176–177 (See N68-14823 05-21)

The discussion centers around displays for low speed, low altitude operations, including helicopters and counter-insurgency type aircraft, and the limitations inherent in the available charts and maps. An attempt is made to hypothesize a display that would be adaptable to various aircraft with a wide range of performance, and theyfactors that influence accuracy are cited. It is pointed out that the design problems of map displays must be tailored to various flight modes; the ability to switch from one to another within the characteristics of operational aircraft is considered essential.
M.G.J.

N68-14850 Human Factors Research, Inc., Santa Barbara, Calif.

DISCUSSION GROUP 4. THE INTERFACE PROBLEM IN MAP-DISPLAY SYSTEM DEVELOPMENT Summary Report

In its Aeron. Charts and Map Displays Aug. 1967 p 178–179 (See N68-14823 05-21)

In discussing the man–machine interface problems in map display development, the two main problems are identified as those relating to the displays themselves, and those related to display development. The problems pertaining to the specific displays are viewed as safety and reliability, map content, display location, capability for all weather flight, map display notation, and map scale. Display development problems are listed as standardization, coordination between groups, the need for exploring exotic techniques, specialized chart requirements, and an assessment of display complexity. The organizations possessing research capability in the area of map display development are listed.
M.G.J.

N68-14857# Aerospace Corp., El Segundo, Calif. Lab. Operations.

LOW ALTITUDE NIGHTGLOW ARCS

David D. Elliott and S. R. La Valle Oct. 1967 14 p refs (Contract F04695-67-C-0158) (TR-0158(3260-10)-1; SAMSO-TR-67-95; AD-662606)

The equatorial region has been surveyed repeatedly for nightglow arcs from a polar-orbiting satellite. The measurements were made at 5577A and 6300A from December 1966 through March 1967, at a local time near midnight. Of the 13 orbits analyzed in detail, there were red (6300A) arcs every night and green (5577A) arcs 9 times out of the 13. The red arcs had a median magnitude of about 150 Rayleighs and occurred predominantly in pairs spaced symmetrically around the magnetic equator (Barbiers tropical red arcs). The green arcs, which had a median magnitude of about 100 Rayleighs and appeared in pairs about half of the time, frequently occurred in coincidence with the red arcs. The red and the green arcs typically occurred at plus or minus 15 degrees magnetic latitude and were about 10 degrees wide. The arcs were not dependent on the planetary magnetic index K sub p.
Author (TAB)

N68-14923 Latvian P. Stuchka State Univ., Riga.

ABOUT CHOICE OF COEFFICIENTS OF FRICTION BETWEEN ATMOSPHERIC AIR AND EARTH

K. Steins and E. Kaupuse *In its* Earth's Rotation Irregularities 1967 p 32–37 refs In RUSSIAN; ENGLISH summary (See N68-14921 05-30)

Angular momentum and moment of force methods for comparing seasonal changes in earth rotation velocity and atmospheric circulation are considered. An attempt was made to improve on the accuracy of these methods by using reference data obtained for heights of several hundred meters over level land, water and wooded areas. Equations were derived, using wind velocity data, for the formation of coefficients of friction over these areas. It is concluded that earth angular momentum exchange can be explained by the coefficients of friction of level surfaces and related water surfaces.
Trans. by E.C.

N68-14968# Agricultural Research Service, Ithaca, N. Y. Soil and Water Conservation Research Div.

THE ENERGY BUDGET AT THE EARTH'S SURFACE: AIR FLOW AND TURBULENCE CHARACTERISTICS IN A JAPANESE LARCH PLANTATION Interim Report

L. H. Allen, Jr. Jun. 1967 41 p refs Sponsored by Army Electron. Command Prepared in cooperation with N. Y. State Coll. of Agr., Cornell Univ., Ithaca, N. Y. (RR-395; ECOM-2-871-2; AD-662720)

Mean horizontal windspeed profiles within and above a plantation of Japanese larch were obtained. A log-profile analysis of above-vegetation windspeeds yielded a wide range of values for the roughness length parameter (zo) and the zero plane displacement height (D), with these two parameters being highly correlated with each other. The computed Eulerian space scale of turbulence within the vegetation showed deeper penetration of large eddies after needle fall and during high winds. Power spectra showed that at the base of the plantation most of the variation in windspeed was associated with gusts of about 100 meters wavelength. Power spectra at the most dense portion of the plantation canopy showed considerable modification due to the tree spacing.
Author (TAB)

N68-14989# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

GEOLOGICAL INTERPRETATION OF THE GRAVITATIONAL AND MAGNETIC FIELDS OF THE BALTIC SEA REGION [O GEOLOGISCHESKOM ISTOLKOVANII GRAVITASIONNOGO I MAGNITNOGO POLEY PRIBALTIKI]

N. M. Rukhovets Nov. 1967 11 p refs Transl. into ENGLISH from Sovet Geologiya (Moscow), no. 4, 1967 p 129–132 (ACIC-TC-1271; AD-662285)

Tectonic movements, which give form to the structure of the sedimentary deposits and to the relief of the crystalline basements internal structure, which, together with the relief and the depth of occurrence of its surface, is the chief factor influencing the nature

of the gravitational and magnetic fields. The following problems are discussed in the translation: (a) The structure of the gravitational field changes substantially, depending of the depth of occurrence, and on the relief of the crystalline basements surface. (b) If boundaries of the first-order tectonic structures are distinctly expressed in the crystalline basements relief in a form of faults of considerable amplitude, then their detection in the gravitational field is easy. The task becomes more complicated when the foundation is without gradients and its relief is smooth. (c) In order to determine the relation of the basements internal structure with its relief and with the structure of the sedimentary deposits, it is necessary to discover the differences in the basements internal structure within the boundaries of the different first-order tectonic structures. (d) Tracing the disjunctive dislocations in the crystalline basement can be solved by way of geological interpretation of the gravitational and magnetic fields. Author (TAB)

N68-14877# Naval Oceanographic Office, Washington, D. C.
U.S. NAVAL OCEANOGRAPHIC OFFICE, GEOMAGNETIC SURVEYS Informal Report
Jul. 1967 83 p refs
(Rept.-67-52; AD-657346)

Since 1953, the U.S. Naval Oceanographic Office has conducted geomagnetic surveys over various ocean areas of the world. Information on survey locations, dates, navigational control, track patterns, data format, and availability of geomagnetic technical reports, charts, and other publications is presented. Author (TAB)

N68-14996# California Univ., San Diego. Marine Physical Lab.
ANISOTROPY OF THE PACIFIC UPPER MANTLE
R. W. Raitt, G. G. Shor, Jr., T. J. G. Francis, and G. B. Morris
1 Nov. 1967 47 p refs
(Contract Nonr-2216(05))
(MPL-U-21/68; SIO-Ref.-67-8; AD-662406)

Seismic refraction measurements of the compressional wave velocity of the upper mantle, obtained in the northeast Pacific Ocean between California and Hawaii, have shown a dependence on direction indicating anisotropy of velocity with a maximum of 8.6 km/sec in a roughly easterly direction and a minimum of 8.9 km/sec. In order to test whether or not these observations represent true anisotropy, rather than geographical variation of velocity, special anisotropy experiments were conducted at two locations centered roughly at 31 degrees N, 121 degrees W and 35 degrees N, 126 degrees W respectively. At each of these locations significant anisotropy was observed, agreeing in direction with the apparent anisotropy indicated for the entire region. The magnitude of the velocity difference, 0.3 km/sec, is half of the overall variation of 0.6 km/sec. These observations do not prove the hypothesis of anisotropy throughout the entire region from California to Hawaii. However, they are consistent with this hypothesis, and give encouragement to similar observations elsewhere. Author (TAB)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-13916# New Zealand. Dept. of Scientific and Industrial Research, Wellington. Physics and Engineering Lab.
A MICROPHOTOMETER WITH LOGARITHMIC OR LINEAR RESPONSE
R. A. Morris and A. R. Morman 21 Jun. 1967 8 p ref
(TN-188) CFSTI: HC $3.00/MF $0.65

Describes the electronic circuits developed for use with a rotating stage microphotometer. The sensing device is a photomultiplier tube and the output is presented on a potentiometric recorder. Both linear and logarithmic modes of operation are available; in the latter the output scale covers four decades of light intensity. Author (ESRO)

N68-13940# Argonne National Lab., Ill.
A PROPOSED SOLUTION TO THE "MATCH" PROBLEM
Vera Pless Jun. 1967 19 p
(Contract W-31-109-ENG-38)
(ANL-7348) CFSTI: HC $3.00/MF $0.65

A method for matching three views of particle track photographs from a bubble chamber with a computer using a few parameters is described. The solution of the matching problem first uses a simple geometric criterion to determine which pair of tracks (from each of the three possible pairs of views) could represent the same track in space. From this, triples of tracks (one from each view) are constructed such that each pair of tracks from the triple could represent the same track in space. An estimator is then associated with each triple and eliminates those whose estimators are too large. The triples are then sorted into equivalence classes and the best triples are chosen depending in part on the estimator. NSA

N68-13958# Oak Ridge National Lab., Tenn.
RADIATION DETECTOR STUDIES
In its Neutron Phys. Div. Aug. 1967 p 94–111 refs (See N68-13952 05-24)

Abstracted data is presented on scintillator and spectrometer design studies and on codes and programs used for associated calculations. Scintillation decay times and instrument response are also reported. Emphasis is placed on neutron and gamma ray detectors. N.E.N.

N68-13973*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
DUCTILITY MECHANISMS AND SUPERPLASTICITY IN CHROMIUM ALLOYS
Joseph R. Stephens and William D. Klopp Washington Jan. 1968 32 p refs
(NASA-TN-D-4346) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Alloys with lower ductile-to-brittle transition temperatures than that of unalloyed chromium (≈300°F or 422°K) included chromium —35 to 40 atom percent rhenium, chromium —15 to 24 atom percent ruthenium, chromium—30 atom percent cobalt, and chromium—30 to 50 atom percent iron. Equilibrium diagrams have two features in common, an intermediate σ phase, and a high maximum solubility of solute in chromium. The following observations were made on alloys with compositions approaching the solubility limit in the chromium–rhenium, chromium–ruthenium, and chromium–cobalt systems and the σ composition in the chromium–iron system: ductile-to-brittle transition temperature decreased significantly; grain size increased sharply with increasing solute content after annealing at a constant temperature; hardness decreased substantially; and initial deformation was primarily by

twinning. The ductile-to-brittle transition temperatures of near saturated alloys can be related to the fractional difference in specific volume between the σ phase and the respective chromium-base solid solution. Chromium—30 atom percent cobalt and chromium—24 atom percent ruthenium alloys were tensile tested at elevated temperatures and exhibited superplasticity. Observation suggests the rhenium ductilizing effect and superplasticity may have common basic features. Author

N68-13974*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FLIGHT EVALUATION OF AN ELECTROSTATIC ACCELEROMETER FOR MEASUREMENT OF LOW-LEVEL ORBITAL ACCELERATIONS

Daniel J. Lesco Washington Jan. 1968 13 p refs

(NASA-TM-X-1488) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The results of the first flight test of an experimental electrostatic accelerometer are presented. Measurements of liquid-hydrogen venting accelerations as low as 6×10^{-5} g were obtained aboard an orbiting Saturn S-IVB stage. Comparison of the accelerometer readings is made with other flight measurements. The time correlation between output data and attitude control system firings is also described. Author

N68-14003# Imperial Coll. of Science and Technology, London (England). Dept. of Geology.

THE IMPERIAL COLLEGE RUBIDIUM STATION MAGNETOMETER: OPERATING MANUAL

M. J. Usher, comp. 1967 87 p

(Rept.-67-1) CFSTI: HC $3.00/MF $0.65

The Rb magnetometer is an atomic oscillator producing a frequency output which is to a first order proportional to the scalar value of the ambient magnetic field. The line shape of the atomic resonance is complex, and results in a slight variation of output frequency dependent upon the precise orientation of the sensor with respect to the field direction 45° for optimum signal). The field equipment consists of the sensing head (comprising sensor and preamplifier) and its thermal enclosure, the control, counter and recorder. These parts are described in detail. Author (ESRO)

N68-14005# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany). Inst. fuer Stratosphaerenphysik.

DEVELOPMENT OF AN ALTERNATING LIGHT MONOCHROMATOR AND ITS USE IN MEASURING AIRGLOW DURING TWILIGHT AND AT NIGHT [AUSBAU EINES WECHSELLICHTMONOCHROMATORS UND SEINE ANWENDUNG ZUR MESSUNG DES LUFTLEUCHTENS WAEHREND DER DAEMMERUNG UND IN DER NACHT]

Guenther Guilino (Ph.D. Thesis—TH Muenchen) 1964 62 p refs In GERMAN

(Rept.-17/1964) CFSTI: HC $3.00/MF $0.65

An interference monochromator based on the alternating light method described by Ehgartner and others (1955) was further developed to enable temporal and spatial changes in the intensity of the airglow to be recorded with adequate resolution. A high-resolution diaphragm plate and an articulated mirror system were constructed; and a narrow-band amplifier system with a phase-sensitive rectifier was added, enabling the signal to be recorded by a robust linear plotter. A working hypothesis was evolved to make allowance for unfavourable meteorological conditions at the observation point. Results from twilight measurement of the sodium-D lines were found to agree with the theory of excitation by resonance scattering. An approximation of the number of free sodium atoms in the atmosphere was arrived at, and the resulting annual pattern fitted in well with the known winter maximum and summer minimum of the northern hemisphere. In individual cases it proved possible to deduce height profiles of sodium atom concentration (with maxima around 90 km), and on 3 Dec. 1963 the appearance of two superimposed sodium layers was recorded. Even in the unfavourable optical conditions of Lindau, usable results were produced in respect of the sodium-D lines and the green oxygen line of the airglow, and the instrument is capable of still further development. ESRO

N68-14006 International Training Centre for Aerial Survey, Delft (Netherlands).

INTERPRETATION OF AERIAL PHOTOGRAPHS FOR THE DELIMITATION OF THE BIOTOPES OF *GLOSSINA MORSITANS* WESTW. AT BUGESERA (RWANDA) [INTERPRETATION DE PHOTOS AERIENNES POUR LA DELIMITATION DES BIOTOPES DE *GLOSSINA MORSITANS* WESTW. AU BUGESERA (RWANDA)]

E. J. E. Buyckx, R. Frankart, and L. Liben 1966 38 p refs In FRENCH; ENGLISH summary

Three methods of interpretation of the aerial photographs were described for a sample area in the Bugesera natural region, in the southeast of the Rwanda Republic, for delimitating the biotope of the tsetse fly *Glossina morsitans* Westw. The third of these methods, based on analytical units which are a combination of physical, natural or man-made elements identified in the morphological and physiographical units, defines the limits of the permanent habitats and feeding grounds in Bugesera with sufficient accuracy to make possible the planning of tsetse fly control campaigns. Discriminative aerial spraying campaigns carried out in this region have revealed that it is a more precise and faster method than mapping the various parts of the biotope by direct observation. If aerial photographs are already available, the method is much less expensive. It appears that the interpretation of aerial photographs may give interesting results in the control *G. morsitans* and the other savannah tsetses, *G. pallidipes* and *G. Swynnertoni*, with which it is often associated. Author

N68-14009# Imperial Coll. of Science and Technology, London (England). Dept. of Geology.

THE HELIUM MAGNETOMETER

M. J. Usher 1966 39 p refs

(Grant FF/8/60)

(Rept.-1966/3) CFSTI: HC $3.00/MF $0.65

This report describes the work completed on the helium instrument both as a total field magnitude magnetometer of the self-oscillating type in low fields only (suitable for space probes) and operating on the locked oscillator technique as a ground magnetometer. ESRO

N68-14018*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DIGITAL READOUT AND CONTROL SYSTEM FOR A 64-INCH (1.63-m) SCATTERING CHAMBER

Lawrence P. Madson Washington Jan. 1968 13 p refs

(NASA-TN-D-4324) CFSTI: HC $3.00/MF $0.65 CSCL 18D

This report describes an automatic digital position control system for scattering chamber now in use with the 60-inch (1.52-m) cyclotron at the Lewis Research Center. It features programmed remote control of detector positions with accuracies of ±0.03 degree for these positions. The system has been in continuous operation for a period of 6 months and has resulted in a 20 percent saving in experiment running time. Author

N68-14019* Techtran Corp., Glen Burnie, Md.
PHOTOGRAPHIC PYROMETRY [FOTOGRAFICHESKAYA PIROMETRIYA]
Yu. N. Shramko Washington NASA Dec. 1967 10 p refs Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur, Akad. Nauk SSSR (Moscow), v. 5, no. 2, 1967 p 367–372
(Contract NASw-1695)
(NASA-TT-F-11407) CFSTI: $3.00 CSCL 14E

Photographic methods of measuring temperatures and the application of these methods in different fields of high temperature physics in the USSR and abroad are described. Basic laws of photographic pyrometry, drawings of photographic pyrometers and the analysis of errors in measuring brightness and color temperatures are presented. Author

N68-14057 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ELECTRONOPTICAL SYSTEMS FOR RECORDING HIGH-SPEED PROCESSES
Iu. E. Nesterikhin and R. I. Soloukhin [1967] 22 p refs Transl. into ENGLISH from the book "Methods of High-Speed Measurement in Gasdynamics and Plasma Physics" Moscow, Nauka Press, 1967 p 88–108

The construction and operation of electro-optical photographic systems for high speed measurements are reviewed, and the advantages in using them are indicated. Multiframe electron optical time magnifiers are described, along with the types of measurements in gas and plasma processes for which they can be used. Attention is also given to the magnetic focusing of the converters. A method is included for determining the spectra line half-widths for plasma temperature measurements in discharges. N.E.N.

N68-14079 United Kingdom Atomic Energy Authority, Harwell (England). Analytical Sciences Div.
MEASUREMENTS OF THE GAMMA-ACTIVITIES OF COBALT AND OTHER NEUTRON FLUX MONITORS USING AN IONISATION CHAMBER
M. J. Cabell and M. Wilkins Jul. 1967 49 p refs
(AERE-R-5179) HMSO: 7s

An apparatus which can be used to determine the absolute γ-activities of irradiated cobalt monitors (and the ^{60}Co equivalent of the activities of other monitors) is described, and its characteristics specified. It incorporates an ionisation chamber. By indirectly relating the activities of the monitors to a number of ^{60}Co primary standards, it has been shown that they can be determined absolutely with an accuracy of ± 3 per cent (2 σ) or better, if they are in the range 4 microcuries to 50 millicuries, or with an accuracy of ± 5 per cent (2 σ) if they are in the range 1 to 4 microcuries. Experimental results are processed by a specially written program, called CIMCA, which has been prepared for the S2 compiler of the IBM 7030(Stretch) computer. Author

N68-14088 Lockheed Missiles and Space Co., Sunnyvale, Calif.
METHODS OF TEMPERATURE MEASUREMENT
Iu. E. Nesterikhin and R. I. Soloukhin [1967] 13 p refs Transl. into ENGLISH from the book "High-Speed Measurement Methods in Gasdynamics and Plasma Physics" Moscow, Nauka Press, 1967 p 142–155

Methods for obtaining high speed measurements in gas dynamic and plasma physic experiments are reviewed. Emphasis is placed on spectroscopic methods based on application of the laws of equilibrium radiation. Specific types of measurements include radiation energy spectrum, spectral line inversion, absorption, and spectrum line intensities and widths. Mention is also made of determinations based on measurements of the speed of sound and other hydrodynamic, temperature dependent parameters. N.E.N.

N68-14098# Sandia Corp., Albuquerque, N. Mex.
AIRBORNE SCANNING PHOTOMETER MEASUREMENTS OF CONJUGATE AURORA
James G. Moore (Naval Weapons Center) and Merton M. Robertson Jul. 1967 6 p
(Contract AT(29-1)-789)
(SC-DC-67-1986) CFSTI: HC $3.00/MF $0.65

Observations were made by a six-color photoelectric scanning photometer in each of two jet aircraft which flew pre-calculated conjugate paths across the northern and southern auroral zones. The colors that were chosen were those of OI at 5577 A and 6300 A and N_2^+ at 3914 A as well as 4012 A, 5605 A, and 6203 A. The observations indicate that auroras are present simultaneously at conjugate points and that the intensities of the same emissions seem to covary in both hemispheres. NSA

N68-14103# Hamburg Univ. (West Germany). Inst. for Experimental Physics.
FABRICATION AND PROPERTIES OF SI(LI)-DETECTORS [HERSTELLUNG UND EIGENSCHAFTEN VON SI(LI)-DETEKTOREN]
G. Maier and B. Zausig Aug. 1967 28 p refs In GERMAN; ENGLISH summary
(BMwF-FBK-67-72)

Investigations were performed on the fabrication methods for Si (Li) detectors and their correlated properties. The resulting technique is presented. Some special tests and results for several properties are described and examples of applications are given. Author (NSA)

N68-14151*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EXPERIMENT M405 (MSC-3), TRIAXIS MAGNETOMETER
William Dan Womack *In its* Manned Spaceflight Expt. Gemini 10 Mission Mar. 1967 p 9–19 ref (See N68-14150 05-30)

Knowledge of the magnetic field magnitude and direction is most important for the evaluation of charged particle measurements, especially where directional instrumentation is employed. Due to the directionality of charged particles within magnetic fields, the measurement of those particles becomes impossible when employing a directional measuring instrument without determining the direction of the magnetic field lines. This report provides a description of the triaxis magnetometic experimental equipment and operation, and the experimental results obtained from the Gemini Titan 10 (GT-10) spacecraft. The results discussed are based solely on data which were evaluated when this report was compiled. Author

N68-14152*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EXPERIMENT M408 (MSC-6), BETA SPECTROMETER
James Marbach *In its* Manned Spacecraft Expt. Gemini 10 Mission Mar. 1967 p 21–36 *ref* (See N68-14150 05-30)
The beta spectrometer experiment was flown on the Gemini X mission to determine, together with experiments M405 (MSC-3) and M409 (MSC-7), the radiation environment both inside and outside

the spacecraft throughout the mission. Its specific purpose was to measure the flux, energy, and spatial distribution of electrons encountered in the South Atlantic Anomaly region of the inner Van Allen radiation belt. The equipment utilized semiconductor detectors in a straightforward pulse-height-analyzer (PHA) design to provide seven channels of flux information over the energy range $0.41 \leq E \leq 4.61$ MeV. A 15° half-angle collimator allowed a determination of the directional distribution of the incident radiation. The data revealed a spectrum similar to those measured on the Gemini IV and the Gemini VII missions. There is evidence that the electron directions are almost entirely confined within a plane normal to the earth's magnetic field direction as has been suggested by previous scientific measurements. Author

N68-14153*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EXPERIMENT M409 (MSC-7), BREMSSTRAHLUNG SPECTROMETER
Reed S. Lindsey *In its* Manned Spaceflight Expt. Gemini 10 Mission Mar. 1967 p 37–48 (See N68-14150 05-30)

Preliminary analysis of data from the Gemini X mission indicates that the bremsstrahlung spectrometer functioned as planned. Bremsstrahlung relative contrate-time spectra are presented for revolutions 6, 20, 32, and 34. It will be possible to construct flux-energy spectra for comparison to theoretically predicted spectra to determine the validity of calculational techniques. Author

N68-14154*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EXPERIMENT M410 (MSC-8), COLOR PATCH PHOTOGRAPHY
John B. Brinkmann and Robert L. Jones *In its* Manned Spaceflight Expt. Gemini 10 Mission Mar. 1967 p 49–53 (See N68-14154 05-30)

A slate supporting four calibrated color targets was photographed during Gemini X extravehicular activity (EVA) to determine if existing outdoor-type color films can accurately reproduce colored objects in the environment of space. The results indicate that color film can be used to obtain photographs in space with a high degree of color fidelity. Author

N68-14155*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EXPERIMENT M412 (MSC-12), LANDMARK CONTRAST MEASUREMENTS
Charles E. Manry *In its* Manned Spaceflight Expt. Gemini 10 Mission Mar. 1967 p 55–57 (See N68-14150 05-30)

The objective of the landmark contrast measurements experiment was to measure the visual contrast of landmarks against their surroundings to determine the relative visibility of terrestrial landmarks from outside the atmosphere. This experiment was not performed by the flight crew because of fuel-usage constraints and time limitations. Author

N68-14156*# Minnesota Univ., Duluth.
EXPERIMENT S001 (S-1), ZODIACAL LIGHT PHOTOGRAPHY
E. P. Ney and W. F. Huch *In* NASA. Manned Spacecraft Center Manned Spaceflight Expt. Gemini 10 Mission Mar. 1967 p 59–61 (See N68-14150 05-30)

The purpose of the zodiacal light photography experiment was to obtain exposures of several subjects of astronomical interest using a lens setting of f/1 and a speed of 30 seconds. These subjects included the airglow, the zodiacal light, and the Milky Way. The 20 photographs obtained are listed. A combination of the following three factors make the pictures obtained difficult to use quantitatively: (1) The film was only one-half as sensitive as the film used during the Gemini 9-A mission. (2) Observations of the same star field in various exposures show that light transmission through the dirty spacecraft window varied by a factor of at least six. (3) The earth horizon was not seen in all the pictures. Author

N68-14157*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPERIMENT S005 (S-5), SYNOPTIC TERRAIN PHOTOGRAPHY
Paul D. Lowman, Jr. and Herbert A. Tiedemann *In* NASA. Manned Spacecraft Center Manned Spaceflight Expt. Gemini 10 Mission Mar. 1967 p 63–72 refs (See N68-14150 05-30)

Approximately 75 pictures useful for the purposes of the synoptic terrain photography experiment were taken on the Gemini 10 flight. Areas covered include North Africa, parts of South America, China, Formosa, and various oceanic areas. Despite various operational difficulties, the experiment can be considered successful. Specific applications of the pictures obtained are apparent in geology, geography, and oceanography. Author

N68-14158*# Environmental Science Services Administration, Washington, D. C.
EXPERIMENT S006 (S-6), SYNOPTIC WEATHER PHOTOGRAPHY
Kenneth M. Nagler and Stanley D. Soules *In* NASA. Manned Spacecraft Center Manned Spaceflight Expt. Gemini 10 Mission Mar. 1967 p 73–79 (See N68-14150 05-30)

The weather photography experiment conducted in the Gemini X mission resulted in over 200 color pictures showing clouds. Southeast Asia was photographed twice during successive revolutions. Convective cloud patterns appear over South America, the Indian Ocean, the Gulf of Mexico, and the Pacific Ocean. Cloud eddies are pictured near the northwest African coast and Guadeloupe Island. Considerable cirrus cloudiness was found near Sumatra and southwest of India. A number of overlapping picture frames have permitted stereoscopic viewing of several cloud levels. Author

N68-14161*# Dearborn Observatory, Evanston, Ill.
EXPERIMENT S013 (S-13), ULTRAVIOLET ASTRONOMICAL CAMERA
Karl G. Henize and Lloyd R. Wakerling *In* NASA. Manned Spacecraft Center Manned Spaceflight Expt. Gemini 10 Mission Mar. 1967 p 97–104 (See N68-14150 05-30)

The purpose of this photography was to obtain data on the ultraviolet radiation (2200 to 3000 Å) of hot stars and to develop and evaluate basic techniques for the photography of celestial objects from manned spacecraft. Twenty-two frames were exposed on the southern Milky Way as the spacecraft's orbital motion caused the camera to scan from Crux to Vela. Author

N68-14167* Melpar, Inc., Falls Church, Va.
GAS VOLUME METER Final Report

Jan. 1968 34 p
(Contract NAS9-5060)
(NASA-CR-65909) CFSTI: $3.00 CSCL 14B

The equipment requirements, the gas volume meter, and the equipment operation are described for measurement of metabolism of the astronauts in 100% oxygen atmosphere. Significant modifications, qualification tests, and calibration curves for the qualification unit are included. Breath volume and temperature, and the partial pressures of oxygen and carbon dioxide are measured. A high accuracy-chromatograph is used for the gas analysis. N.E.N.

N68-14188 Weather Bureau, Silver Spring, Md. Equipment Development Lab.
A WIND VECTOR COMPONENT ACCUMULATOR
Herman H. Crouser Dec. 1967 16 p ref
(WBTM-EDL-3)

A technique is described for obtaining and displaying wind vector components for the four cardinal points of direction. This device is intended to relieve the need for the laborious manual extraction of wind data from analog wind records. The user needs to combine the four component values to obtain the resultant vector that shows the mean wind speed and its corresponding direction. In addition to the vector components the accumulator also indicates the total wind passage. Author

N68-14196# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MICROWAVE TECHNIQUES FOR REACTOR INSTRUMENTATION
T. R. Billeter and D. P. Brown 19 Oct. 1967 20 p Presented at the 15th Conf. on Remote Systems Technol. and Atom Fair, Chicago
(Contract AT(45-1)-1830)
(BNWL-SA-1314; CONF-671102-27) CFSTI: HC $3.00/MF $0.65

Microwave techniques and equipment for measuring various physical properties in nuclear reactors, especially those reactors expected to operate at radiation levels and temperatures which obviate the use of conventional measurement techniques, are investigated. Techniques are described to minimize problems of insulation degradation and spurious noise interference. A thermal neutron flux monitor and temperature sensor system are described. NSA

N68-14210# Brookhaven National Lab., Upton, N. Y.
SIGNAL PROCESSING FOR HIGH-RESOLUTION PULSE AMPLITUDE SPECTROMETRY
V. Radeka [1967] 26 p refs Presented at Conf. on Semicond. Radiation Detectors and Circuits, Gatlinburg, Tenn., 13–15 May 1967
(BNL-11794; CONF-670520-12) CFSTI: HC $3.00/MF $0.65

A general discussion of filters for high-rate, high-resolution pulse amplitude spectrometry is presented. Included topics are signal and noise, signal and noise processing, and rate considerations. NSA

N68-14214# Iowa State Univ. of Science and Technology, Ames.
OPERATION OF AN X-RAY AND A NEUTRON DIFFRACTOMETER CONTROLLED BY A NON-DEDICATED COMPUTER SYSTEM
D. J. Dahm, J. E. Benson, D. M. Nimrod, D. R. Fitzwater, and R. A. Jacobson 1 Mar. 1967 9 p ref
(Contract W-7405-ENG-82)
(IS-1701) CFSTI: HC $3.00/MF $0.65

The x-ray and neutron diffractometers under discussion are Hilger and Watts four-circle devices. Simultaneous control of these and other instruments is accomplished with a real-time computer system consisting of an SDS 910 computer linked to magnetic disks by an IBM 1401 computer. The operation of this system is discussed and compared with other automated systems currently in operation. A complete set of programs for data collection including crystal alignment, generation of indices and angles, monitoring of standard reflections, and measurement of peaks and backgrounds have been written. Each program handles only a small portion of the task; additions of substitutions of programs are therefore easily implemented by the user to change the mode of operation. The same set of programs may also be recombined by writing one short calling program. Author (NSA)

N68-14228# California Univ., Berkeley. Lawrence Radiation Lab.
PATTERN RECOGNITION IN BUBBLE CHAMBERS
Howard S. White 22 Jun. 1967 28 p refs Presented at the Seminar on Computerized Imaging Tech., Washington, D. C., 26–27 Jun. 1967 Sponsored by the AF
(Contract W-7405-ENG-48)
(UCRL-17635; CONF-670627-2) CFSTI: HC $3.00/MF $0.65

A review of the scanning and measurement systems for analyzing particle tracks from bubble-chamber photographs is presented. Discussed are conventional measurement systems, manually directed–computer assisted systems, manual scanning–automatic measurement systems, and entirely automatic measurement systems. NSA

N68-14241# Argonne National Lab., Ill.
WIDE-RANGE COUNTING-CAMPBELLING NEUTRON-FLUX DETECTION SYSTEM
G. F. Popper, W. C. Lipinski, and J. M. Harrer Apr. 1967 45 p refs
(Contract W-31-109-ENG-38)
(ANL-7224) CFSTI: HC $3.00/MF $0.65

A neutron-detection system that uses a single fixed-position neutron detector to continuously monitor up to ten decades of reactor power was assembled and tested. The system had good gamma discrimination over the entire neutron-flux range. A conventional counting technique was used to cover the source and low intermediate ranges, and a statistical chamber current fluctuation technique (Campbelling System or Mean Square Voltage System) was used to monitor the intermediate and power ranges. The system's response to neutron flux and the change in the system's response, when different cables were used between the detector and preamplifier, were measured. In addition, some of the basic parameters of a standard fission counter were also measured. NSA

N68-14298 Argonne National Lab., Ill.
INVESTIGATION OF DARK FIELD SCOTCHLITE
M. Bougon *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 19 p Sponsored by AEC (See N68-14281 05-24)

Comparison of the scattering functions of Scotchlite and liquid hydrogen established the feasibility of Scotchlite dark field photography at 12 to 15 degree angle between the light and the camera. An experiment with a simulated, large bubble chamber geometry has shown that the usable bubble diameter is decreased from 500μ in a bright field to 300μ with dark field Scotchlite. G.G.

N68-14299 Wisconsin Univ., Madison.
PHOTOGRAPHY, EXPANSION DYNAMICS, OPTICAL INHOMOGENEITIES OF THE MURA MODEL HEAVY LIQUID CHAMBER
C. A. Baumann, U. Camerini, W. F. Fry, M. C. Gams, R. H. Hilden et al *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 31 p (See N68-14281 05-24)

The development of Scotchlite reflective coating of sufficiently fine grain and uniformity makes it possible: (1) to decrease required illumination power in bubble photography; (2) to obtain smaller bubble size images with no change in brightness with chamber depth; (3) to overexpose uniformly so that images on the film are smaller than the resolving power of the lens; (4) to lower the background-to-noise ratio in automatic track following equipment because the image of the film is clear against a blackened background; and (5) to locate the lights outside the chamber. Photographs of cosmic ray tracks three milliseconds after arrival in the bubble chamber show a good contrast in liquid freon medium. The complete dynamics of liquid and gas must be calculated to find the most desirable chamber expansion without oscillation excitations and to prevent optical inhomogeneities caused by temperature differences. G.G.

N68-14301 Milan Univ. (Italy).
PRELIMINARY STUDIES ON PICTURE ANALYSIS FOR "GARGAMELLE"
E. Fiorini and P. Negri *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 15 p (See N68-14281 05-24)

Nuclear interactions were simulated in a full scale optical model of a heavy liquid bubble chamber with fiducial marks installed on the walls and inside the chamber. Curved aluminum wires were used to represent particle tracks taken from earlier heavy liquid bubble chamber experiments. Pictures from eight camera positions at the same 110° angle for a propane filling were used to test the fiducial marks, the performance of the scanning and measuring projector, and the reconstruction of the events. A computer program was employed to reconstruct the fiducials through consecutive camera reference data. G.G.

N68-14313# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DYNAMIC BALANCING OF ROTORS USED IN INSTRUMENT MAKING [DINAMICHESKOYE URAVNOVESHIVANIYE ROTOROV, PRIMENYAYEMYKH V PRIBOROSTROYENII]
V. Ye. Nyachin 11 Apr. 1967 22 p Transl. into ENGLISH from Tr. Aviats. Tekhnol. Inst. (Moscow), no. 59, 1964 p 40–53
(FTD-MT-24-97-67; AD-662477)

Dynamic balancing consists of determining the magnitude and location of the imbalance and then eliminating or controlling it while a rotor is rotating. These two problems are solved separately at different stages. The first problem is solved by changing the rotary motion of the rotor into angular oscillatory motion about its axis where the maximum angular deviation is on the order of a few degrees. The angular location of the imbalance as well as its magnitude are determined by the same transducers. The schematic diagram of the proposed method is shown. The method can be briefly described as follows: The imbalanced rotor rests on two supports I and II suspended on springs of given stiffness h sub 1 and h sub 2 directed along two coordinate axes. The rotor is set into oscillatory motion by one of three methods discussed in the paper. The problem now is to determine the amounts of metal which must be added or removed from the surface of the rotor, and their location, in order to balance it. The mechanical oscillations of the supports, caused by the imbalance, are measured by means of transducers (e.g., piezoelectric transducers); the angular displacements of the investigated rotor alpha sub 1 and alpha sub 2 are measured by means of ratiometers. The sensitivity of the method is determined on an example of a symmetrical rotor whose imbalance is due only to the displacement of its mass center from the axis of rotation, r. The paper shows two schematic diagrams of two versions of the method for the determination of a dynamic imbalance. TAB

N68-14348# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYSTEM OF CONTROLLING AZIMUTHAL INSTRUMENTS WITH THE AID OF A DIGITAL ARITHMETICAL MACHINE [SISTEMA UPRAVLENIYA AZIMUTAL'NYMI INSTRUMENTAMI S POMOSHCH'YU TSIFROVOY ARIFMETICHESKOY MASHINY]
Yu. B. Arkhangel'skiy and V. A. Myasnikov 1 May 1967 17 p refs Transl. into ENGLISH from the Publ. "Institut Elektromekhaniki. An SSSR" Moscow, Izd.-Vo. Nauka, 1965 p 128–136
(FTD-HT-66-451; AD-662550)

There is an acute need for accurate and reliable automatic control systems for the regulation of real time of astronomic instruments, radiolocators, and other azimuthally mounted instruments. After discussing the requirements imposed on such control devices, the present author discusses a particular combined radiotelescope control system capable of operating with a low-speed digital computer utilizing a relatively small number of elements and exhibiting increased reliability. The operation of the system is described and a program for guiding and tracking is presented. The time diagram of one cycle of computer and control device operation is given. TAB

N68-14372# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
A TIME-DIVISION ANALOG MULTIPLIER USING AN IMPROVED FUEL-WAVE MODULATOR TO MAINTAIN STATIC ACCURACY
J. R. Nielsen Aug. 1967 44 p refs
(Contract AT(10-1)-205)
(IDO-17221) CFSTI: HC $3.00/MF $0.65

In the field of analog computers there is a need for an electronic analog multiplier which can maintain a high degree of static accuracy for long periods of time. The requirements on bandwidth are low since computer problems are usually time-scaled for display on pen recorders. A time-division multiplier that was developed using all solid-state construction is described. It maintains a static accuracy of 0.1 percent of full-scale output for long periods of time and has a usable bandwidth of 1 kHz. Author (NSA)

N68-14373 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany).
ON THE OPTICAL DETERMINATION OF THE SIZE DISTRIBUTION OF AEROSOLS [UEBER DIE OPTISCHE FESTSTELLUNG DER GROESSENVERTEILUNG VON AEROSOLEN]
Hanns-Bernhard Seiler (Ph.D. Thesis—Ludwig-Maximilians-Univ.) 1967 161 p refs In GERMAN; ENGLISH summary

A high speed aerosol spectrometer is described. The device is fit for use in aircraft, measuring luminous flux of scattered light from individual particles. Since particles are measured in the free air flow, influence of any thermic or pressure change is avoided. The method is characterised by big scattering angles, non monochromatic illumination, small counting loss. Automatic recording of the spectrum is easily performed. Experiments were made using pure water droplets of 5/μm to 15/μm radius. Author

N68-14379* National Aeronautics and Space Administration, Washington, D. C.
ELECTROSTATIC ANALYZER FOR THE DETECTION OF FAST NEUTRAL PARTICLES [UN ANALYSEUR ELECTROSTATIQUE POUR LA DETECTION DES NEUTRES RAPIDES]
F. P. G. Valckx Jan. 1968 13 p refs Transl. into ENGLISH from Rept. EUR-CEA-FC-255
(NASA-TT-F-11458) CFSTI: $3.00 CSCL 14B

The paper presents a description of the instrument and the results of control and standardization measurements which have been carried out. A 90° electrostatic deflector analyzes the energy of the particles, which are pre-ionized in a gas target. The maximum energy is 200 keV. The resolving power can be varied from 0.05 to 2.5%. Author

N68-14400*# ADCOM, Inc., Cambridge, Mass.
DESIGN AND PERFORMANCE EVALUATION REPORT
Charles J. Boardman, Ahmad J. Ghais, and Robert L. Chufo 1 Nov. 1967 52 p
(Contract NAS5-10539)
(NASA-CR-91669; G103-T1) CFSTI: HC $3.00/MF $0.65 CSCL 14C

The specific objectives of this study are: to experimentally determine the error performance of the proposed recording method for various packing densities, to demonstrate that it is feasible to extract bit synchronization from a split-phase data sequence which has been recorded in the recommended manner, and to compare the performance obtained with the performance of conventional techniques for split-phase recording. Author

N68-14416# California Univ., Los Angeles. Dept. of Engineering.
DESIGN OF A GRAPHIC DISPLAY SYSTEM
B. B. Coggan Aug. 1967 192 p refs
(Contract AT(11-1)-GEN-10)
(TID-24087) CFSTI: HC $3.00/MF $0.65

The basic specifications are described for a Graphic Display System that is designed to handle two areas of application: use as a special-purpose device for the control of an instrumentation system, and observation; and use as a general purpose display device that is capable of defining reasonably complex structures which will be useful to a broad field of application programs. Existing systems are first surveyed, the basic concepts of engineering graphics are studied, and specific instrumentation display requirements are discussed. Finally, this information is used to derive the basic specification for a visual information processor that will satisfy the given constraints. Author (NSA)

N68-14419# California Univ., Berkeley. Lawrence Radiation Lab.
MP-2 INFORMATION MANUAL
John M. Ferguson 7 Jun. 1967 48 p refs
(Contract W-7405-ENG-48)
(UCRL-17611) CFSTI: HC $3.00/MF $0.65

The logic systems of the Measuring Projector Two (MP II) or "Franckenstein" for bubble chamber film analysis are described, and diagrams and some adjustment procedures are given. No attempt has been made to explain the electronic circuitry associated with the logic systems. Author (NSA)

N68-14449# Stanford Univ., Calif. Dept. of Physics.
A PERSISTENT CURRENT MAGNETOMETER WITH NOVEL APPLICATIONS
John M. Pierce *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 10 p refs Sponsored by ONR (See N68-14447 05-23)

Applications are described for a current magnetometer with a closed superconducting circuit, a portion of which can be driven normal by the switch heater. This magnetometer can be compared to a Foner device and has approximately the same output power as that obtained in a normal LR circuit if the magnetized sample is vibrated at a specified frequency. Performance of the basic circuit can be improved by resonating it with a capacitor, and a resonant magnetometer circuit is illustrated. The thermally switched modulator, essentially a hollow cylinder of indium film, is discussed; it is noted that inductance can be modulated by 10% frequencies up to 100 kHz. This modulator must be operated in a region where the field is constant in time roughly to the sensitivity desired for the magnetometer. Use of the magnetometer circuit for measuring electron paramagnetic resonance in water solutions is described. M.W.R.

N68-14452# California Univ., La Jolla.
A SUPERCONDUCTING GRAVIMETER
W. M. Prothero, Jr. and John M. Goodkind *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 12 p Sponsored by NSF (See N68-14447 05-23)

A gravity meter with applications in geophysics is described that supports a test mass with a magnetic field generated by persistent current magnets. The device levitates a superconducting ball over a persistent current magnet, and the field geometry is arranged so that the force gradient on the ball is very small in the vertical direction. The ball is a hollow aluminum shell that weighs 4.5 g and is 1 in. in dia. Detection schemes currently in use are a magnetic one that uses a superconducting transformer and flux detector to measure flux pattern changes caused by the motion of the ball, and an electrostatic scheme that uses a capacitance bridge. Feedback and readout systems are discussed. M.W.R.

N68-14469# Cornell Univ., Ithaca, N. Y. Dept. of Engineering Physics.
OPERATION OF SUPERCONDUCTING INTERFERENCE DEVICES IN APPRECIABLE MAGNETIC FIELDS
Malcolm R. Beasley and Watt W. Webb *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 8 p refs Sponsored by AEC and ARPA (See N68-14447 05-23)

A device used to study flux creep in superconductors is described that is capable of resolving magnetic field changes of less than 10^{-7} gauss with a 1 sec time constant in an applied field of 2500 gauss. A field resolution of better than one part in 10^{10} was obtained by such a superconducting interference device or a SQUID. Secondary modulation and flux creep in material of the SQUID are discussed, and it is noted that it is only necessary to keep the field at the SQUID due to the high field magnet below that level which would produce secondary modulation. SQUID construction is shown, as is the arrangement of a superconducting dc transformer that permits SQUID operation for a day without any readjustment of the points and achieves critical current modulation which does not change in time and is independent of applied magnetic field. M.W.R.

N68-14537# Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics.
A SINGLE CRYSTAL SLOW NEUTRON SPECTROMETER AT THE PULSED REACTOR IN DUBNA
J. Gordon, P. Pellionisz, I. Vizi, G. Zsigmond, and A. Szkatula 1967 14 p refs
(KFKI-8/1967)

A spectrometer built for combination of monocrystal and time-of-flight techniques is described. The wavelength resolution is

1.5%, while the time resolution of the spectrometer is 18 μsec/m with normal water and 25 μsec/m with the polyethylene–beryllium cooled moderator. For the latter the slow neutron flux at the sample is 30 neutrons/cm^2 sec. The background is less than 0.6 neutrons/hour for 16 μsec channel width on a detector surface of 250 cm^2. As an example of application the distribution curve for critical scattering on iron is presented. Author (NSA)

N68-14595# California Univ., Berkeley. Lawrence Radiation Lab.
DIFFERENTIAL THERMAL CALORIMETRIC DETERMINATION OF THE THERMODYNAMIC PROPERTIES OF KAOLINITE
Patrick Stephen Nicholson (Ph.D. Thesis) Sep. 1967 53 p refs
(Contract W-7405-ENG-48)
(UCRL-17820) CFSTI: HC $3.00/MF $0.65

A differential thermal calorimeter was calibrated by measuring the heat content of SiO_2(quartz) and α-Al_2O_3 between room temperature and 1100°C. The results were compared with accepted literature values and agreement to ±2% observed. Differential thermal calorimetric values of 305, 250 and 280 cals/mole for the $\alpha \rightarrow \beta$ quartz inversion also compared favorably with the accepted 290 cals/mole. Having demonstrated the accuracy of the instrument, thermodynamic property estimations were undertaken on kaolinite. Author (NSA)

N68-14631# New York Univ., N. Y. School of Engineering and Science.
TESTING OF MICROELECTRONICS: THE ELECTRON MICROPROBE AND THE SCANNING ELECTRON MICROSCOPE
Rolando Garcia Nov. 1967 56 p refs
(Contract NObsr-89288; Proj. SETE)
(SETE-210/91; AD-662687)

An electron probe is a finely focused beam of electrons accelerated through a potential of 5 to 40kv. When this beam strikes a substance, it induces several phenomena whose effects can yield information about the irradiated area. This report is concerned with two types of electron probe instruments, the Electron Microprobe Analyzer and the Scanning Electron Microscope. The principles of operation, capabilities, and design considerations for each instrument are discussed. Their application to the testing of microelectronic circuits and components is described by examples taken from current technical literature, and by figures and photographs which illustrate the results that can be obtained with these instruments. A tabulation containing a partial list of commercially available microprobe analyzers and scanning electron microscopes together with their specifications and a bibliography of books, periodicals, and patents on electron probe instruments and related topics are included. Author (TAB)

N68-14659# Naval Ship Research and Development Center, Washington, D. C. Hydromechanics Lab.
STATIC AND DYNAMIC CALIBRATION OF PROPELLER MODEL FLUCTUATING FORCE BALANCES
John H. Brandau Aug. 1967 75 p refs
(Rept.-2350; AD-662400)

Balance systems and techniques for model-scale measurement of up to six components of the fluctuating propeller forces produced by nonuniform inflow conditions were developed. Balances which achieve a broad nonresonant measuring range along with high signal to noise ratio were developed with two degrees of freedom mechanical designs. Analytic methods employing lumped mass and spring and estimated damping representations have aided in balance design. Devices and methods for statically and dynamically calibrating these balances so that accurate relationships between balance signals and actual propeller forces are described. A dynamic calibration procedure utilizing small electromechanical force inducers attached in place of the test propeller on the rotating balance shaft is used to determine the frequency response of each of the balances force transducers. Interaction effects on transducer signals of force components produced in planes other than the principal transducer plane are small on the latest balance designs. Although relatively satisfactory calibrations were achieved to date with this schema, improvements in monitoring amplitude and phase of calibrator input forces should be pursued to assure maximum accuracy in calibration. Author (TAB)

N68-14661# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va. Topographic Labs.
CONCEPT FOR AN ULTRAPRECISE GEODETIC BASELINE
Kenneth D. Robertson Nov. 1967 18 p refs
(RN-24; AD-662268)

A concept is presented for an ultraprecise geodetic baseline with an accuracy approaching 1 part in 10 to the 8th power. The method proposed is that of optical interferometry using the long coherence length and precise wavelength characteristics of the stabilized single frequency gas laser. As proposed, the baseline might also serve as a calibration range for distance-measuring equipment and for a very accurate determination of the velocity of light. Author (TAB)

N68-14674# National Severe Storms Lab., Norman, Okla.
A PRELIMINARY EVALUATION OF THE F-100 ROUGH RIDER TURBULENCE MEASUREMENT SYSTEM
U. O. Lappe (Turbulence Consultants, Inc.) Oct. 1967 34 p refs Sponsored by ASD, AF, and FAA
(Contract W66-170)
(IERTM-NSSL-36)

Response data for elevator control inputs are used as a basis for evaluating the F-100 aircraft gust measurement systems. The procedure involves: (1) use of the gust equation to evaluate responses of the aircraft maneuvered in a zero-gust (nonturbulent) environment; (2) analysis of the separate responses, with the aid of calculated frequency response functions, to isolate probable instrumental problems; and (3) estimation of overall gust velocity measurement accuracies from estimates of equivalent gust velocities obtained from measured and calculated responses. The analysis indicates that with pitch dampers off, the overall error for the F-100 gust measurement system ranges from a threshold value of about 5 ft/sec to a maximum error of about 20 ft/sec. The accuracy estimates (error per unit gust velocity) range from a few percent to about 60 percent; the pitch damping system (in use during flights within thunderstorms) should reduce the maximum error to about 30 percent. Author

N68-14699# Galileo Ferraris National Electrotechnical Inst., Turin (Italy).
DIGITAL TECHNIQUE FOR RECORDING TIME DEPENDENT SPECTRA BY TIME TO PULSE HEIGHT CONVERSION, PART A Final Scientific Report
Guido Bonfiglioli, Piero Brovetto, and Cesare Cortese Apr. 1967 19 p refs
(Grant AF-EOAR-66-27)
(AFOSR-67-2784; AD-662627)

The present note describes the construction of the electronics to be used for recording time-dependent spectra of electroluminescent

crystals. The fundamentals of the digital method employed to measure the distribution of delay between the excitation and the emission are briefly outlined pointing out its interest for our problems. The electronic circuitry is then described and some preliminary experiments are reported, that demonstrate the performance of the whole setup. Author (TAB)

N68-14701# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NEW TRENDS IN THE DEVELOPMENT OF GYROSCOPES [NOVYYE NAPRAVLENIYA RAZVITIYA GIROSKOPOV]

M. I. Zaytsev and G. A. Slomyanskiy 11 Apr. 1967 21 p refs Transl. into ENGLISH from Aviats. Tekhnol. Inst. Tr. (Moscow), no. 59, 1964 p 5–16

(FTD-MT-24-96-67; AD-662485)

The design of a synchronous ceramic gyromotor fixed on aerodynamic bearings is presented and its advantages over gyromotors on ball bearings are discussed. The Cardan suspension, the gyrostatic suspension with two and three degrees of freedom and the hydrostatic suspension with two degrees of freedom are discussed. A Sperry gyroscope consisting of a cylinder with a liquid spherical rotor is discussed. Several other foreign gyroscopes operating on different principles are also described. TAB

N68-14714# Bendix Corp., Kansas City, Kans.

REPORT ON DEVELOPMENT OF INDUCTANCE STANDARDS

H. E. Simpson Jul. 1967 15 p

(Contract AT(29-1)-613)

(BDX-613-98) CFSTI: HC $3.00/MF $0.65

A set of standards was developed to meet the demands for precision inductors in the range from 0.05 μH to 100 μH. The standard inductors are repeatable, well defined and usable over a frequency range from 1 kHz to 2.5 MHz, and provide suitable devices for the comparison of unknown inductors. Precision connector type inductance standards were developed. The inductors employ binding post connections on 3/4-in. centers with separate shorting terminals which provide a definite standardizing condition. NSA

N68-14820# Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland).

MEASUREMENT OF PRESSURE BY A COMPENSATED THERMOCOUPLE SYSTEM AND A CHOPPER AMPLIFIER, POWERED BY BATTERIES [MESURE DE LA PRESSION PAR UN SYSTEME A THERMOCOUPLE COMPENSE ET A AMPLIFICATEUR DECOUPER, ALIMENTE PAR BATTERIES]

H. Ripper Aug. 1967 13 p refs In FRENCH; ENGLISH summary

(LRP-32/67)

The construction of a battery-powered gage which measures the pressure in a discharge tube is described. This gage is based on a compensated thermocouple used in conjunction with a chopper-amplifier. Typical calibration curves are shown. Author (NSA)

N68-14843 Army Map Service, Washington, D. C.

NEW MAP FORMS

Lynn R. Wickland *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 146–149 (See N68-14823 05-21)

The various factors involved in processing and producing the Pictomap (photographic image conversion by tonal masking procedures) are described. The basic steps are identified as three tonal separations photographically extracted from a photomosaic; block-out masks; drafted symbols and names data; and the combination of the tonal separations with the block-out masks at the platemaking stage. Special tonal colors are used in printing; drafted symbols, grid, names, and marginal data are added in specific colors to produce the finished map. Consideration is also given to the quality of the photographs, the tonal range for the photography, map scale, types of terrain, and ground cover. Mention is made of the Joint Operations Graphic, a 1:250,000 scale map or chart with air data overprint, designed for use by all the services. M.G.J.

N68-14894# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

INSTRUMENT DEVELOPMENT BRANCH ANNUAL REPORT, 1966

Ned Wilde, T. J. Boland, and S. D. Anderson Jul. 1967 112 p refs

(Contract AT(10-1)-205)

(IDO-17234) CFSTI: HC $3.00/MF $0.65

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3. INSTRUMENTATION ANALYSIS N. Wilde p 88–96 (See N68-14897 05-14)

N68-14895# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

DETECTOR DEVELOPMENT

S. D. Anderson *In its* Instr. Develop. Branch Ann. Rept., 1966 Jul. 1967 p 1–38 (See N68-14894 05-14)

Details are given on detector and transducer development, and on related measuring and testing techniques. Instrument materials development is also described. High temperature measurements are emphasized, and measurements taken during reactor transients and nucleate boiling are included. N.E.N.

N68-14896# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

INSTRUMENT COMPONENT AND SYSTEMS DEVELOPMENT

T. J. Boland *In its* Instr. Develop. Branch Ann. Rept., 1966 Jul. 1967 p 39–87 (See N68-14894 05-14)

The instrumentation development reported is for reactor and nuclear technology, emphasizing safety technology. Instrument controls and monitors are described, and fuel element and health physics instrumentation is covered. N.E.N.

N68-14897# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

INSTRUMENTATION ANALYSIS

Ned Wilde *In its* Instr. Develop. Branch Ann. Rept., 1966 Jul. 1967 p 88–96 (See N68-14894 05-14)

Detector techniques of measuring cross spectral density functions of reactor neutron noise were extended to include subcritical and fast reactors, and measurements were made on four

cores. Analog computer circuits capable of solving reactor dynamics equations on a continuous basis for reactor power transients with a range of 13 decades were developed. The large dynamic range is achieved by performing a logarithmic transformation of the zero power kinetics equations. Author

N68-14907# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
MEASUREMENTS OF SHOCKFRONTS IN ARGON FILLED MEMBRANE SHOCKTUBES MADE WITH A DIFFERENTIAL INTERFEROMETER [DIFFERENTIALINTERFERO STOBFRONTEN IN ARGONGEFUELLTEN MEMBRANSTOBROHREN]
W. Zimmermann Sep. 1967 35 p refs In GERMAN; ENGLISH summary
(IPP-3/57)

After presenting the essential features of the differential interferometer using Wollaston prisms, its application to the investigation of shock wave structures is described. The possibilities and limitations of the method are discussed. It is shown that the influences of shock front curvature and shock front thickness on the shift of interference fringes cannot be separated. Within the limits set by the accuracy of the measurements and calculations the results agree with the expectations. Author

N68-14909# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
A MICROWAVE INTERFEROMETER FOR WIDEBAND MEASUREMENTS OF COMPLEX TRANSMISSION COEFFICIENTS OVER THE X-BAND [MIKROWELLENINTERFEROMETER ZUR BREITBANDIGEN MESSUNG DES KOMPLEXEN TRANSMISSIONSKOEFFIZIENTEN EINES MESSOBJEKTS IM X-BAND]
O. Gehre Oct. 1967 16 p refs In GERMAN; ENGLISH summary
(IPP-3/61)

A wideband (8.3–11.5 GHz) microwave interferometer was developed to measure the complex transmission coefficient of samples inserted in the waveguide system. The amplitude A and phase shift ϕ are presented either in polar coordinate form $A \cdot e^{i\phi}$ as frequency is swept or as A cos ϕ and A sin ϕ versus frequency. The unique feature of this system is its capability to measure over extremely broad frequency bands. The system was tested with components with known characteristics and used to measure transmission of a thin sheet of water. Author

N68-14926 Latvian P. Stuchka State Univ., Riga.
ABOUT SOME ERRORS OF THE PHOTOELECTRIC DEVICE OF THE ASTRONOMICAL OBSERVATORY OF THE LATVIAN UNIVERSITY
K. Steins and E. Kaupuss *In its* Earth's Rotation Irregularities 1967 p 79–95 refs In RUSSIAN; ENGLISH summary (See N68-14921 05-30)

The following photoelectric device errors were found and investigated by means of oscillographs and artificial star equipment: (1) false signals, (2) 50 cps oscillations (from alternating current), (3) different time constants due to poor regulation of photomultiplier voltage. Author

N68-14958*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
SPACE PHOTOGRAPHY
Richard W. Underwood *In its* Gemini Sum. Conf. 1967 p 231–290 (See N68-14941 05-30)

Presented is a representative selection of color photography from various Gemini missions and a brief description of their informational content. S.C.W.

N68-14987* Geological Survey, Washington, D. C.
AERIAL INFRARED SURVEYS IN WATER RESOURCES STUDIES
R. M. Moxham Apr. 1967 20 p refs
(NASA Order R-146-09-020-006)
(NASA-CR-91776; NASA-74) CFSTI: $3.00 CSCL 20F

New types of infrared line scanning radiometers record very small relative variations in earth surface radiance. This permits thermal patterns to be mapped in great detail, especially in surface waters. The technique has been useful in finding the location of ground-water discharge into marine coastal waters and in studying the circulation and diffusion of natural waters, and of liquid discharge from industrial plants. The quantity and spectral distribution of infrared radiance from natural surfaces is a function of temperature and emissivity. As emissivity of water is nearly unity, radiance variations are due chiefly to temperature variations. The infrared line scanner, carried in an aircraft, generates a photograph-like image whose gray scale is a measure of the infrared radiance of land and water surfaces along the flight path. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-13938# Argonne National Lab., Ill.
NONDESTRUCTIVE INSPECTION OF EBR-II FUEL-JACKET TUBING USING ELECTROMAGNETIC TECHNIQUES
Thomas H. Busse, Donald R. Wood, and Norman S. Beyer May 1967 29 p refs
(Contract W-31-109-ENG-38)
(ANL-7334) CFSTI: HC $3.00/MF $0.65

Approximately 136,000 ft of EBR-II fuel jacket tubing was inspected using eddy current techniques to eliminate all tubing that might prove detrimental when used. Quality requirements specified that wall defects or localized reduction of wall thickness equal to or greater than 10% of the wall thickness must be rejected. In the first inspection 22.48% of the 42,984 ft of welded tubing and 28.83% of the 13,925 ft of seamless tubing were rejected. After a different tube heat treatment there was only a 9% rejection. The long-term performance of the pulsed eddy current flow detector, which is described, is good. Equipment failures were minor and down time was minimal. NSA

N68-13939# Argonne National Lab., Ill.
EVALUATION OF MAGNETIC PULSE FORMING AS A JOINT FABRICATION TECHNIQUE FOR CP-5 FUEL ELEMENTS
L. G. Kuncl, R. B. Hegemann, and J. Kotora, Jr. Jun. 1967 29 p refs
(Contract W-31-109-ENG-38)
(ANL-7343) CFSTI: HC $3.00/MF $0.65

Magnetic pulse forming, a high-energy rate metal-working process, has been investigated and evaluated as a substitute fastening technique for fabricating CP-5 fuel elements. This process produces joints whereby aluminum tubing is magnetically swaged into machined aluminum casting grooves. A number of samples produced by this technique have been tested to destruction. Visual and dimensional inspection of the samples revealed a high degree of constructional uniformity. The tensile- and compression-test results have shown consistently high strength. The joints were unaffected by thermal cycling in the temperature range simulating the operating environment of the reactor. Higher temperatures, over 600°F, caused a strength reduction of about 40%, but the joint strength was still more than adequate for the CP-5 reactor application. Because of the high strength of the joint, the consistency of this strength over many samples, and the economics inherent in the simple fabrication and inspection techniques, the magnetic-pulse-formed joint appears to be a desirable and feasible fastening method for CP-5 fuel-element joints. Author (NSA)

N68-13969# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

DESIGN, CALIBRATION, AND CAPABILITIES OF SOLID STATE PISTON-CYLINDER AND "BELT" ULTRA HIGH PRESSURE EQUIPMENT

G. L. Kulcinski Sep. 1967 26 p refs
(Contract AT(45-1)-1830)
(BNWL-465) CFSTI: HC $3.00/MF $0.65

The general design characteristics of "Belt" and "Piston-Cylinder" high pressure–high temperature equipment capable of pressures to 60 kbar and temperatures to 1500°C are described. The methods of calibrating such equipment by noting resistance changes in cerium, bismuth, thallium, and barium, and volume changes in RbCl and KI, are described in detail. It has been found that for a given load, the pressure on a sample enclosed in a collapsible can filled with a liquid is the same as that determined by noting phase changes in samples imbedded in AgCl sleeves. This result means that calibration curves which have been determined by normal techniques can be used with confidence when using a collapsible can technique for applying hydrostatic pressure. The general capabilities of such equipment are discussed in terms of pre- or postirradiation pressure treatments of materials which are of interest to nuclear metallurgists. Author (NSA)

N68-13970# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

DESIGN AND CALIBRATION OF AN ULTRA-HIGH PRESSURE X-RAY CELL

G. L. Kulcinski Sep. 1967 40 p refs
(Contract AT(45-1)-1830)
(BNWL-438) CFSTI: HC $3.00/MF $0.65

A device to generate pressures up to 50 kbars (≈750,000 psi) has been designed to function in the environment of a nuclear reactor. Its overall cylindrical dimensions are 2.4 cm diam and 3.3 cm long. It has been adapted to yield optical and X-ray information, before and after irradiation, on a sample under pressure. Calibration of this device, by noting the X-ray lattice parameter shift of NaCl and the optical absorption shift of TlBr, is described. It has been shown that the pressure on a powdered sample surrounded by a metallic washer is considerably lower than that predicted by a simple force/area ratio. It is also shown that the pressure gradients on a powdered sample contained between diamond anvils are reduced by surrounding it with a metallic washer. Author (NSA)

N68-13978# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

RADIATION STUDIES ON GRAPHITE WITH CONTROLLED PROCESSING

J. H. Cox, Jr. Aug. 1967 22 p refs
(Contract AT(45-1)-1830)
(BNWL-502) CFSTI: HC $3.00/MF $0.65

The effect of graphitization temperature, crystallite orientation, impregnation, and density on the dimensional stability of graphite under neutron irradiation is described. The investigation of the effect of graphitization temperature involved five series of samples, with final processing temperatures of 700 to 3000°C. Increased processing temperature resulted in an appreciably lower radiation induced contraction rate. The most pronounced effect was found at temperatures below 2500°C. In graphites identical except for crystallite orientation a linear relationship was found. A higher coefficient of thermal expansion resulted in a lower contraction rate. In graphites identical except in impregnant level, increasing the impregnant level above a threshold, 16% for the series studied, resulted in the contraction rate increasing with impregnant level. Increasing the density of graphite did not affect the radiation induced dimensional changes. Author (NSA)

N68-13986# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

EFFECTS OF SOME PROCESS TEMPERATURES ON RADIATION INDUCED CONTRACTION OF GRAPHITE

J. H. Cox, Jr., R. W. Marek, and W. E. Parker (Air Reduction Co., Inc., Niagara Falls, N. Y.) Sep. 1967 16 p refs
(Contract AT(45-1)-1830)
(BNWL-489) CFSTI: HC $3.00/MF $0.65

The dimensional change that occurs during the thermal processing of graphite and the subsequent dimensional change that occurs when graphite is irradiated has been explored. A lower rate of rise to the graphitization temperature yielded a slight improvement in dimensional stability under neutron irradiation for the transverse orientation; however, in the parallel orientation there was no appreciable effect of graphitization rate on dimensional stability. A second series of samples was used to demonstrate the degree to which binder heat treatment influences radiation induced dimensional changes. The filler for the formulation was graphitized to 2900°C and then mixed with a graphitizable binder. Differences in radiation induced contraction can be attributed to the binder phase. There is little effect of heat treatment temperature down to 2000°C; at heat treatment temperatures below 2000°C there is a sharp increase in contraction rate for both orientations. Author (NSA)

N68-14014# Union Carbide Nuclear Co., Oak Ridge, Tenn.

MACHINE TOOL EVALUATION STUDIES

J. S. Oakwood 17 Oct. 1967 46 p refs
(Contract W-7405-ENG-26)
(Y-1588) CFSTI: HC $3.00/MF $0.65

A series of tests has been performed to evaluate specific machine-tool characteristics. Empirical data pertaining to horizontal turning machine spindles were collected under normal shop conditions. Some conclusions have been inferred from the data presented. It is the primary purpose of this report, however, to focus attention upon the present state of the art with respect to machine-tool capability. Author (NSA)

N68-14097# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.

TANGENTIAL RADIOGRAPHY FOR DIMENSION MEASUREMENTS

R. E. Cofield and S. G. Snow 29 Sep. 1967 51 p refs Presented at the 27th Natl. Fall Conf. of the Soc. for Nondestructive Testing, Cleveland, 16–19 Oct. 1967 Submitted for publication
(Contract W-7405-ENG-26)
(Y-DA-1583; CONF-671002-3) CFSTI: HC $3.00/MF $0.65

Tangential radiography is a useful tool for measuring the thickness of walls and adjacent layers; particularly those having spherical, cylindrical, and related geometries; when the surfaces are not accessible for conventional measurements. The radiation opacity contrasts encountered are evaluated mathematically for a range of practical dimensions and the interacting effects of layer thickness, radius of curvature, and absorption coefficient for the penetrating radiation used are described. Practical tangential radiography techniques for measuring wall thickness and individual layer thicknesses in multilayered structures are reported. Masking, filtration and compensation methods which improve the imaging and measurement of thickness are described. Experiments in the use of scanning microdensitometry for measuring dimensions for tangential radiographic images have been performed and are discussed. Author (NSA)

N68-14131* IIT Research Inst., Chicago, Ill. Technology Center.
MATERIAL PREPARATION AND INSTRUMENTATION FOR WELDING S-IC COMPONENTS Final Report
(Contract NAS8-20363)
(NASA-CR-61181; IITRI-B6065-15) CFSTI: $3.00 CSCL 13H

This program deals with the defect potential of surfaces of 2014 and 2219 aluminum alloys examined by optical reflectance, mass spectrometry, gas chromatography, spark emission spectroscopy, radioactive tracer, and light and electron microscopy techniques. Surface analysis was used in conjunction with a spot-weld test to identify and measure the surface conditions that create defects in welds. It was determined that surface contamination, including adsorbed liquids and vapors and the oxide layer, is a major source of weld defects. The conventional surface preparations of chemical cleaning, solvent degreasing, wire brushing, and scraping contaminate the surface and produce a high defect potential. Spark emission spectroscopy proved to be the most useful technique for the chemical analysis of surface contamination. Scanning electron microscopy is most suitable for revealing the physical nature of contaminated surfaces. The results of the spot-weld tests were confirmed in butt-welded panels. The spot-weld test is simple and economical, and could be readily adapted for quality control of surface preparations. Author

N68-14172*# Pratt and Whitney Aircraft, East Hartford, Conn.
DEVELOPMENT OF MAINSHAFT SEALS FOR ADVANCED AIR BREATHING PROPULSION SYSTEMS, PHASE 1 Final Report, 25 Jun. 1966–25 Jul. 1967
A. J. Parks, R. H. McKibbin, C. C. W. Ng, and R. M. Slayton 14 Aug. 1967 230 p refs
(Contract NAS3-7609)
(NASA-CR-72338; PWA-3161) CFSTI: HC $3.00/MF $0.65 CSCL 13I

Four mainshaft seals for advanced gas-turbine applications were designed, tested and analyzed. The seals studied were a rubbing-contact face seal with piston-ring secondary seal, a rubbing-contact face seal with bellows secondary seal, an orifice-compensated hydrostatic seal, and an orifice-compensated externally pressurized seal. In addition, a hybrid seal was tested and analyzed. Results of the testing and analysis indicated that the gas-film seals appeared to have the potential to accommodate these environments while rubbing-contact seals lacked the development potential to operate at elevated temperature levels, high relative speeds, and a wide range of pressure differentials. Author

N68-14190# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ACOUSTIC EMISSION IN METALS AS A NDT TOOL
Philip H. Hutton Sep. 1967 15 p refs Presented at the 27th Natl. Fall Conf. of the Soc. for Nondestructive Testing, Cleveland, 18 Oct. 1967
(Contract AT(45-1)-1830)
(BNWL-SA-1262; CONF-671002-4) CFSTI: HC $3.00/MF $0.65

The potential of acoustic emission as nondestructive testing and metallurgy research tools is discussed. Acoustic emission is the pressure wave produced by energy released by deformation and fracture. With adequate sensors and signal amplification, these pressure waves can be detected at the surface which is deforming or cracking. Applications include monitoring flaw growth in reactor pressure tubes; remote and continuous surveillance of operational systems, such as natural gas pipe lines, and aircraft structures to detect flaw formation and growth; monitoring welds for cracking during cooling; monitoring hydrostatic testing of missile fuel tanks; tool for fracture research in metallics and nonmetallics; and monitoring space vehicles for micrometeorite penetration. NSA

N68-14549# Union Carbide Nuclear Co., Oak Ridge, Tenn.
AUTOMATIC CENTERING INSPECTION MACHINE
Rasey R. Feazell 13 Oct. 1967 96 p refs
(Contract W-7405-ENG-26)
(Y-1594) CFSTI: HC $3.00/MF $0.65

The inspection of accurately machined parts which are surfaces of revolution requires the part to be placed precisely in the center of a rotary inspection machine. This is normally done manually, requiring considerable time and an experienced inspector. A two-axis, sampling-type control system was designed to perform this operation automatically without the use of skilled operators. The ultimate centering accuracy is limited by the mechanical performance of the inspection machine. Specifically, the accuracy is limited by the blacklash and free play of the cross slides on this particular machine. Two design-aiding computer programs are also reported. Author (NSA)

N68-14579* Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
DETERMINATION OF THE COEFFICIENT OF FRICTION BETWEEN METALS AND NONMETALS IN ULTRAHIGH VACUUM Final Report
G. Mohr and L. L. Karafiath Dec. 1967 70 p ref
(Contract NAS8-5415)
(NASA-CR-61439; RE-311) CFSTI: $3.00 CSCL 13I

Friction tests at pressures below 2×10^{-9} torr were performed; in 19 of the vacuum tests, the pressures were in the 10^{-10} torr range or lower. Supplemental tests under atmospheric conditions were conducted for the purpose of comparison. The test temperature was the same in all cases, normal room temperature between 20 and 25°C, with a relative humidity controlled at about 35 percent. Friction between basalt and quartz powders (in two particle size range, 250–500 microns and 38–62 microns) and metal disks (steel 1020 and aluminum 7075) were measured under these two conditions. Computer programs based on the least squares method were used to obtain best fitting first and third order curves. From an initially high value the coefficient of friction declined rapidly with time until it reached a nearly constant value of kinetic friction. Author

N68-14655*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CRYOGENIC INSULATION MANUFACTURING TECHNOLOGY
Iva C. Yates, Jr. *In its* Res. Achievements Rev., Vol. 2 1967 p 43–53 refs (See N68-14651 05-32)

This paper describes manufacturing techniques and processes used to apply high performance multilayer insulation systems to flight type cryogenic tanks. The methods used in the application of a helium purged concept and a pre-evacuated concept are reported, and the problems associated with each concept are discussed. It is concluded from these application studies that manufacturing technology is available for the application of high performance insulation systems to cryogenic tanks for short term space storage. Additional studies are needed to more completely assess the effect of manufacturing methods on thermal performance and to develop insulation systems for long term storage of cryogens in space. Author

N68-14858* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

DEVELOPMENT OF A COMBINED HIGH PERFORMANCE MULTILAYER INSULATION AND MICROMETEOROID PROTECTION SYSTEM

James M. Stuckey *In its* Res. Achievements Rev., Vol. 2 1967 p 55–68 (See N68-14651 05-32)

The helium purged system consists of an outer micrometeoroid bumper of polyurethane resin impregnated glass cloth and a multilayer insulation of alternate layers of double aluminized Mylar film reflective shields and thin sliced polyurethane foam spacers. The four combined concepts that have been evaluated include two concepts with and two concepts without a special ground-hold insulation section inserted between the multilayer space insulation and the tank wall. Author

N68-14728 Technische Hochschule Hannover (West Germany). Maschinenwesen.

RESEARCH ON TRIBOMECHANICALLY EXCITED SOLID BODY REACTION: FRETTING CORROSION [UNTERSUCHUNGEN UEBER TRIBOMECHANISCH ANGEREGTE FESTKOERPERREAKTIONEN: REIBKORROSION]

Rudolf-Walter Heinemann (Ph.D. Thesis) 1967 211 p refs In GERMAN

Friction corrosion and the resulting material degradation was analyzed for solid mechanical machine parts and metal joints. The friction process induced oxidation followed by fretting corrosion of the involved surfaces; even proper lubrication could not prevent metal abrasion. A corrosion test apparatus was constructed and used to evaluate all corrosion parameters in metal friction processes; it was concluded that surface degradation increased with increased loads and high friction intensities; fretting corrosion was higher in a dry, oxygen rich atmosphere than in humid air and also increased at lower temperatures. Transl. by G.G.

N68-14744# California Univ., Livermore. Lawrence Radiation Lab.

BEAM LINE LIQUID HELIUM CRYOPUMP

Balwant S. Denhoy 16 Sep. 1967 19 p Presented at the 14th Ann. Symp. of the Am. Vacuum Soc., Kansas City, Mo., 24–27 Oct. 1967

(Contract W-7405-ENG-48)

(UCRL-70590; CONF-671017-1) CFSTI: HC $3.00/MF $0.65

A beam line liquid helium cryopump has been designed and built for Alice (a neutral-injection, controlled thermonuclear research machine). The pump prevents large quantities of hydrogen and other residual gases from entering into the ultrahigh vacuum environment chamber for plasma. The beam line cryopump consists of an annular tube through which the neutral energetic beam passes. The annular volume is connected to a helium reservoir above it by two well-insulated and shielded lines. Thermal syphoning effect causes the circulation of liquid helium from the annular pumping surface to the liquid helium reservoir and eliminates the presence of gas pockets and hot spots on the pumping surface. This pump has a 4800-cm^2 bare metal cryogenic pumping surface that can be subcooled to the Lambda point or lower. The pumping speed for hydrogen was measured at 2°K to be 100,000 liters/sec at a system pressure of 8×10^{-10} torr. The heat leak was measured to be 0.75 watt. Author (NSA)

N68-14790# Mechanical Technology, Inc., Latham, N. Y.

HIGHER ORDER APPROXIMATIONS IN THE ASYMPTOTIC SOLUTION OF THE REYNOLDS EQUATION FOR SLIDER BEARINGS AT HIGH BEARING NUMBERS

R. C. Di Prima 13 Nov. 1967 33 p refs

(Contract Nonr-3730(00))

(MTI-67-TR-87; AD-662240)

The methods of matched asymptotic expansions are used in a systematic manner to obtain the load-carrying capacity of an infinitely long slider bearing correct through terms O (1/lambda) where lambda is the bearing number. The expression for the load is extremely simple. It is shown that the error is O (1/lambda squared), and the procedure for obtaining higher order terms is discussed. Results are given for the case of a converging film thickness with a parabolic shape and for a partial arc journal bearing. Author (TAB)

N68-14811 United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.

THE USE OF THE ULTRASONIC PULSE METHOD FOR NON-DESTRUCTIVE TESTING OF HIGH TENSION INSULATORS

C. Stueber Feb. 1967 9 p refs Transl. into ENGLISH from Ber. Deut. Keram. Ges. (Bonn), v. 44, no. 1, 1967 p 20–22

(AERE-TRANS-1077) HMSO: 1s 9d

The method can be developed into a non-destructive technique to supplement all the other known techniques of testing high tension insulators. Flaws not visible from outside can be detected in this way in time during the manufacturing process so that the use of faulty insulators in long-distance power lines or railway power lines may be avoided. Author

N68-14861 Martin Co., Denver, Colo.

CENTER FOR HIGH ENERGY FORMING Annual Report

Gaylen A. Thurston Aug. 1967 168 p refs Presented at the 1st Intern. Conf., Estes Park, Colo., 19–23 Jun. 1967 Prepared in Cooperation with Denver Univ.

(Contract DA-19-066-AMC-266(X))

(CR-65-77; AMRA-CR-66-05/10; AR-2; AD-661081)

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N68-14862 Martin Co., Denver, Colo.
PLASTIC STRAINS IN CIRCULAR BLANKS FORMED INTO ELLIPSOIDAL DIES
Gaylen A. Thurston *In its* Center for High Energy Forming Aug. 1967 p 1–32 refs (See N68-14861 05-15)

An analysis and an associated computer program that predict strains in a symmetrical blank forced into an ellipsoidal die is described. The results of the analysis serve as a guide in predicting whether a given dome shape formed in one explosive forming shot will fall between the two formability limits of tearing or wrinkling. If the dome cannot be formed in one shot, the computer program will calculate the strains in the blank after it has been partially formed, stress-relieved, and formed again. Using the program in this fashion, the number of shots required in a multiple-shot forming operation can be estimated. Author

N68-14863 Martin Co., Denver, Colo.
BLANK STABILIZATION
In its Center for High Energy Forming Aug. 1967 p 33–48 (See N68-14861 05-15)

Different concepts that were tested for controlling edge pull-in of blanks are discussed. One method consisted of adding a lip on the holddown ring and providing a raised rim on the blank. The first rims were made by masking the edge of the blank and chem-milling down the interior to a thinner size. Two domes manufactured in this manner are depicted. To reduce costs, chem-milling was then replaced by laying a weld bead around the edge of the blank. To control wrinkling in addition to pull-in, a chevron ring was developed to replace the lip on the holddown ring. Parameters of tests on other chevron patterns and rims are also given. L.S.

N68-14864 Martin Co., Denver, Colo.
STRAIN AND PRESSURE MEASUREMENTS DURING FORMING
In its Center for High Energy Forming Aug. 1967 p 49–64 refs (See N68-14861 05-15)

The techniques and instrumentation capability required to obtain dynamic strain measurements on the blank during the forming operation were developed. An evaluation of strain gages, adhesives, waterproofings and lead wire attachment techniques was made to the depth required to obtain some preliminary results. In addition, one pressure transducer was evaluated with the objective of obtaining simultaneous pressure and strain data. A total of 24 instrumented blanks were formed. A total of 10 potential sources of error in the strain measurement system were evaluated resulting in some cases in correction factors to be applied to the measured strain. Some useful strain data were acquired on a 14 3/4 in. diameter 2014-0 A1 blank providing information on the strain rates at two radial measurement points, a measure of the repeatability of strain histories, details of the strain event, and the total forming time. Author

N68-14865 Martin Co., Denver, Colo.
THE USE OF AN EXPANDING RING FOR DETERMINING TENSILE STRESS–STRAIN RELATIONSHIPS AS FUNCTIONS OF STRAIN RATE
C. R. Hoggatt, W. R. Orr, and R. F. Recht *In its* Center for High Energy Forming Aug. 1967 p 65–86 refs (See N68-14861 05-15)

Dynamic uni-axial tensile stress–strain data were obtained at high strain rates by measuring the kinematics of thin ring specimens expanding symmetrically by virtue of their own inertia. Impulsively loaded to produce high initial radial velocities, expanding rings are decelerated by the radial component of the hoop stresses. After loading, internal pressure is zero. Differential equations of motion are evaluated experimentally to obtain the stress–strain (constitutive) relationships which govern the magnitude of the hoop stresses. Results can be interpreted directly in terms of true-stress/true-strain relationships. The techniques for producing symmetrical expansion and measuring radial acceleration are the most critical. Experimental data for 6061-T6 aluminum are presented. Author

N68-14866 Martin Co., Denver, Colo.
THE EFFECT OF DYNAMIC STRAIN RATES ON ROOM-TEMPERATURE DUCTILITY
R. N. Orava *In its* Center for High Energy Forming Aug. 1967 p 87–116 refs (See N68-14861 05-15)

A review is presented of data pertinent to the effect of static and dynamic strain rates on room-temperature tensile ductility as expressed by: strain at the onset of plastic instability; total elongation; and reduction in area. The author concludes from these findings that during forming, the ductility of materials with an FCC matrix and some with an HCP matrix can be enhanced in general by the application of increasingly higher static deformation rates, and deformation velocities corresponding to strain rates in the high dynamic range, when the governing criterion is the instability strain. Conversely, the same conditions are expected to be detrimental to the ductility of BCC-matrix materials during forming. The hitherto unexplained strain-rate sensitivity of the instability strain is interpreted on the basis of the uniformity of macroscopic deformation in conjunction with work-hardening and rate-controlling dislocation processes. Author

N68-14869 Martin Co., Denver, Colo.
AN INVESTIGATION OF THE EFFECT OF EXPLOSIVE STANDOFF DISTANCE ON THE FORMING OF METAL BLANKS
A. A. Ezra and M. Malcolm *In its* Center for High Energy Forming Aug. 1967 p 177–194 (See N68-14861 05-15)

This investigation was conducted in preparation for the task of explosively forming 10' diameter domes out of 2014-O aluminum alloy, using water as the medium for transferring energy from the explosive to the blank. Measurements were made to find out the most desirable standoff distance which would result in the most uniform strain distribution in the formed blank, the most uniform draw of the blank, the minimum thickness reduction, and would require the least amount of explosive. Previous observations had shown that each of these factors was affected by standoff distance in some fashion. However, a much clearer understanding of these variables was necessary to permit an intelligent selection of the standoff distance, since the possibility existed that the desired requirements could be mutually contradictory. Author

N68-14870 Martin Co., Denver, Colo.
THE EXPLOSIVE FORMING OF 10 FEET DIAMETER ALUMINUM DOMES
A. A. Ezra (Denver Univ.) and J. E. Adams *In its* Center for High Energy Forming Aug. 1967 p 195–265 refs (See N68-14861 05-15)

The successful explosive forming of 10 ft diameter ellipsoidal aluminum domes with a ratio of major to minor axis equal to $\sqrt{2}$:1 using a thin shell fiberglass die is described. The entire process, including the details of the thin shell die, was developed on a 1/5 scale model, 2 ft in diameter. The results were scaled up to full size using previously developed scaling laws. The full scale domes were formed in a single shot from a flat blank of 2014-0 aluminum alloy, 165 inches in diameter and 3/4 inch thick. The contour and thickness distribution were measured and found to agree well with predictions based on scale model tests. Author

N68-14900# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE CALCULATION OF WORKING STRESSES DURING THE PRESSING OF HOLLOW SHAPES IN DIES WITH BUILT-IN CORE PINS
M. Z. Yermanok, L. S. Skoblov, and T. M. Filina 3 Aug. 1967 14 p refs Transl. into ENGLISH from Tsvetnyye Metally, no. 3, 1966 p 74–77
(FTD-HT-66-728; AD-662206)

The objective of the work was the refining of the formulas of I. L. Perlin for determining the forces of the pressing into the tongued die of round tubes and the development of procedure for determining the forces of pressing of shaped hollow profiles. TAB

N68-14963# Naval Avionics Facility, Indianapolis, Ind.
PROJECT FAATE Summary Report
1 Sep. 1967 23 p
(TP-338; AD-662191)

Contents: Development and use of fault isolation charts; Controlled experiment; Application of digital computer techniques to the generation of fault isolation routines, computer approach, FAATE computer applications, description of circuit analysis program used, production of binary fault isolation flow chart using CODED and CIRCUS. TAB

N68-14972*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SLEEVE BEARINGS MADE OF DU MATERIAL Test Report, Aug.–Dec. 1961
R. M. Norman 18 Jun. 1962 12 p
(Contract NAS7-100)
(NASA-CR-91774; JPL-TM-33-87) CFSTI: HC $3.00/MF $0.65 CSCL 13I

DU bearings were subjected to series of tests in which only the load was varied while the vacuum, shaft size and finish, and speed were held constant. It was found that load capability is markedly greater in normal atmosphere than in vacuum. It is thought that the mechanism of failure of heavily loaded DU bearings in vacuum is a combination of extreme local heating and bearing-bronze galling on the shaft. For a hardened 3/8 in. diam. stainless steel shaft with 2.5–4.5 rms μ-in. finish rotating continuously at 100 rpm in vacuum, the maximum desirable load is 700 psi, although 250–350 psi may be desirable for design objective. C.T.C.

N68-14982# Westinghouse Electric Corp., Baltimore, Md. Product Support and Equipment Dept.
PROJECT FAATE, PHASE 1 Final Report
1 Oct. 1967 170 p refs Reprint
(Contract N00163-66-C-0413)
(TP-339; AD-662190)

The report consists of three separate parts: Part I contains background information and a summary of the overall program; Part II presents a detailed account of a controlled experiment that was performed to verify the BFIC concept; and Part III exhibits the development of a computer approach used to generate Fault Isolation routines, and the results obtained. TAB

N68-14990# Vitro Labs., West Orange, N. J.
DEVELOPMENT OF ELECTROPHORETIC PROCESS FOR COATING T-53 AIR DIFFUSER, EXHAUST DIFFUSER, AND COMBUSTION CHAMBER HOUSING WITH "SERMETEL W", PHASE 2 Technical Report, Aug. 22, 1966–Nov. 6, 1967
Kenneth A. Gebler 6 Nov. 1967 24 p
(Contract DAAJ01-67-C-2207(G))
(VL-2488-2-0; AD-662754)

The report covers activities accomplished to develop an electrophoretic coating method for the application of SERMETEL W to all critical surfaces of the exhaust diffuser, air diffuser and combustion chamber housing of the T-53 engine. SERMETEL W has been classified by various engine manufacturers and DOD agencies as the best coating available for corrosion protection. During this phase the coating tanks with associated recirculation system were run for an extended period, cleaned and adjusted. The humidification chamber installation also was completed and checked for proper performance. Studies of coating dispersion characteristics were begun. Two characteristics, the effect of cathode area on current density and the effect of the age of the dispersion on current, were studied. Utilizing representative segments of the three components, dummy coating runs were made to determine coating coverage. Electrode design was modified as determined necessary to provide complete coverage. Based on successful dummy runs with the sectors, fabrication of electrodes for the full size components was initiated. The electrodes for the combustion chamber housing were completed during this period. Author (TAB)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-14070*# Sylvania Electric Products, Inc., Mountain View, Calif.
STUDY OF VIBRATION MEASUREMENT BY LASER METHODS
Gail A. Massey Washington NASA Jan. 1968 74 p refs
(Contract NAS2-3643)
(NASA-CR-985) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Described are techniques for using laser radiation to detect and measure vibration of mechanical structures. Two methods were developed analytically and experimentally. One of these methods, the intermediate frequency optical heterodyne system, provides quantitative data about the motion of a particular very small area on the mechanical structure. The other method is a qualitative interference technique for observing the vibrational mode patterns, so that the number of points to be measured by other methods can be reduced. A breadboard optical heterodyne system was built, and detection of audio frequency vibrations at levels from one

centimeter to less than 0.1 micron peak-to-peak has been achieved with a variety of surface materials. The performance of this system using two different types of demodulation circuits was investigated. A model structure was fabricated for tests involving comparisons of the qualitative and quantitative methods. It has been shown that a very good knowledge of the vibrational modes can be obtained using the two methods in combination. The qualitative interference method also has been extended to include the measurement of axes of rotation. Author

N68-14122# Defence Standards Labs., Maribyrnong (Australia).
THE TRANSFER EFFICIENCY OF LASER PUMPING CAVITIES WITH DIFFUSELY REFLECTING WALLS
D. R. Skinner Nov. 1966 13 p refs
(Rept.-292)

A measure of the transfer efficiency of a diffusely reflecting laser pumping cavity was obtained by subjecting a laser crystal to a pump flash wall below threshold and measuring the slope of a plot of fluorescent output intensity against electrical input energy. The efficiency was measured for four pumping cavities, all identical except for reflectivity. Calculations of the expected efficiency were made both by the Monte Carlo method and on the assumption that the light inside the cavity was isotropic. Results of the two types of calculations were consistent, and no significant differences were found between experimental results and theory. It is concluded that diffusely reflecting cavities may conveniently be treated as if the light inside the cavity were isotropic. S.C.W.

N68-14178*# Stanford Univ., Calif. Microwave Lab.
INVESTIGATION OF COHERENT SOURCES OF INFRARED RADIATION Semiannual Status Report, 1 May–31 Oct. 1967
R. L. Schawlow Nov. 1967 19 p refs
(Grant NGR-05-020-166)
(NASA-CR-91727; ML-1601; SASR-3) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Methods of generating and detecting far infrared radiation and their application to problems of physical interest are discussed. Consideration is given to the application of the Appleton–Hartree equations for the propagation of electromagnetic waves in a cold magnetoionic medium without collisions, according to the plasma birefringence hypothesis. It is assumed that lasering begins during the moments of sharply-falling attenuation and the plasma frequency falls below the light frequency. The plasma birefringence is obtained for a simple model of the discharge current, magnetic field, and gain cross-section. Implied electron density as a loss mechanism is discussed along with the effects of electron density on laser behavior. The case of applied longitudinal magnetic fields on far infrared lasers is given. B.S.D.

N68-14404# Sandia Corp., Albuquerque, N. Mex.
GB-LIDAR SYSTEM
Murphy J. Landry and Jerrel R. Lochner Sep. 1967 21 p Presented at the Seminar in Depth on Laser Range Instrumentation, El Paso, Tex.
(Contract AT(29-1)-789)
(SC-DC-67-1948; CONF-671015-1) CFSTI: HC $3.00/MF $0.65

The design of a mobile laser (lidar) system for detecting artificial clouds composed of ablative materials from re-entry vehicles is presented. Data from evaluation studies in which the laser energy was reflected from stationary, slow-velocity, and low-and high-energy targets are presented. NSA

N68-14748# Perkin-Elmer Corp., Norwalk, Conn.
ACOUSTIC SELF-TRAPPING OF LASER BEAMS Semiannual Technical Summary Report No. 1, Period Ending 31 Oct. 1967
Edwin L. Kerr 31 Oct. 1967 50 p refs
(Contract N00014-67-C-0488; ARPA Order 306; Proj. Defender)
(Rept.-8995; AD-662281)

Internal filamentary glass damage caused by high power Q-switched pulse lasers has been reported in the literature. Also, filamentary trapping in liquids has been observed. This report presents a theory of acoustic beam trapping. In the theory, electrostriction is the sound wave driving force and sound wave compressions cause focusing of the light wave fields. The theoretical trapping thresholds are calculated from the laser wavelength and the density, refractive index, Youngs modulus, and Poissons ratio of a solid material, or the density, refractive index, and speed of sound of a liquid medium. The acoustic trapping thresholds agree with experimental glass damage thresholds to within experimental accuracy, and they vary the same way with initial beam size. Trapping movies showing the formation of strongly focused regions are presented. An explanation is given for most of the salient features observed in the damage phenomenon. An analysis of Kerr effect trapping is also presented for purposes of comparison. Author (TAB)

N68-14774# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
OPTICAL PUMPS FOR LASERS, PHASE 2 Triannual Report, 1 Apr.–31 Jul. 1967
C. H. Church, D. A. Larson, I. Liberman, and R. G. Young Oct. 1967 87 p refs
(Contract DA-28-043-AMC-02097(E))
(ECOM-02097-5; Rept.-5; AD-662252)

The work covered in the report can be separated into three tasks. The goal of Task A is to improve the lifetime of xenon flash lamps when operated under high repetition rates. In Task B, the object is to predict the performance of a cw laser system when pumped with a spectral gas discharge lamp. The main emphasis on this task will be the prediction of the spectrum from the lamp and its overlap with an experimentally determined excitation spectrum of a laser material. Verification of the theory and the development of the theory will be done by constructing lamps and measuring their spectral characteristics. Laser tests will also be performed if time and funds are available. In Task C the highly efficient pumping of Nd:YAG with a K-Hg lamp is to be demonstrated experimentally. Tasks A and B are new areas of study and therefore little in the way of results have been obtained. In Task A, based on information obtained in the literature, a lamp design for improving lifetime has been proposed. The lamp is basically an all quartz body with a molybdenum ribbon electrical feedthrough. In Task B the theoretical approach has been described. Experimental lamps have been constructed and their spectral outputs measured under both cw and pulsed operation. In Task C, a continuation of last years effort, an increase of output power from 9.85 watts to 12.9 watts at 1000 watts input has been measured. By increasing the lamp excitation from 500 Hz to 3000 Hz a much larger improvement is expected. Author (TAB)

N68-14796# Utah Univ., Salt Lake City.
LASER TEMPERATURE JUMP STUDIES OF FAST REACTIONS Final Technical Report, Dec. 1, 1966–Nov. 30, 1967
Edward M. Eyring 30 Nov. 1967 20 p refs
(Grant AF-AFOSR-476-66-A)
(AFOSR-67-2800; AD-662615)

Progress is reported on three lines of investigation: The use of Joule heating and laser temperature jump equipment to

study the rate of molybdate polymerization is described in detail. The same equipment was used to study the rapid deprotonation by hydroxide ion of a family of azo dyes in alkaline aqueous solution that have strong intramolecular hydrogen bonds. Preliminary results are reported of a kinetic study of the hydrolysis of chromium (III) perchlorate in acidic aqueous solutions. Author (TAB)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-13977# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
HEAT TREATMENT OF THE ALLOY ZR-2.5 WT % NB
T. E. Michaels Sep. 1967 20 p refs
(Contract AT(45-1)-1830)
(BNWL-546) CFSTI: HC $3.00/MF $0.65

Heat treatment effects on Zr–2.5 wt % Nb are described. Five areas were studied qualitatively: microconstituent survey, recrystallization, isothermal transformation characteristics, aging characteristics, and tensile properties as a function of solution heat treatment temperature. Author (NSA)

N68-13994# Iowa State Univ. of Science and Technology, Ames.
AN INVESTIGATION OF THE CHARACTERISTICS OF HYDROGEN CHARGED VANADIUM METAL
Donald Harold Sherman (M.S. Thesis) Aug. 1967 76 p refs
(Contract W-7405-ENG-82)
(IS-T-194) CFSTI: HC $3.00/MF $0.65

Specimens of 99.8% iodide V with 110 micro grain diameter were thermally charged to a H_2 concentration of 50 ppM and tested at twelve temperatures over the temperature range 77°K to 298°K at a strain rate of 0.005 min^{-1}. A detailed percent reduction in area versus temperature curve was obtained in order to establish the ductile to brittle to ductile transition temperatures. The temperature dependence of the yield stress and fracture stress was determined. Five grain size groups (26, 41, 61, 110, and 174 micron grain diameter) of uncharged V and V charged with 50 ppM H_2 were tested at 77°K, 193°K, and 298°K to determine the grain size dependence of the yield stress and flow stress. The experimental evidence of the present investigation indicated that the mechanism controlling the embrittlement of V must greatly reduce the effective surface energy associated with fracture. Author (NSA)

N68-14022# Los Alamos Scientific Lab., N. Mex.
THE FRICTION INDEX AND PRESSING CHARACTERISTICS OF SPHERICAL STAINLESS STEEL POWDER AND OXIDIZED COPPER POWDER
H. Sheinberg 14 Jun. 1967 9 p refs
(Contract W-7405-ENG-36)
(LA-3739) CFSTI: HC $3.00/MF $0.65

A procedure is described for accumulating data on the friction index and compression ratio of a copper powder at different stages of oxidation and screened fractions of a stainless steel powder. The dimensionless and nameless powder property, friction index divided by the compression ratio, under certain conditions, was constant for a regular series of size fractions of stainless steel powder. Calculations were made of the coefficient of compression and the limiting value of the degree of volume change in the manner of Kawakita. Author (NSA)

N68-14040# Los Alamos Scientific Lab., N. Mex.
CHARACTERIZATION OF COMMERCIAL CARBIDE POWDERS
R. E. Riley 25 Oct. 1967 29 p refs
(Contract W-7405-ENG-36)
(LA-3653) CFSTI: HC $3.00/MF $0.65

The problems associated with the development of a procurement specification for commercial carbide powders through powder characterization are reported. The morphological types of structures observed in commercial NbC, TaC, and ZrC powders are discussed. Also given are the results obtained for the various parameters determined to characterize powders. A technique for using these parameters in developing a procurement specification for a carbide powder to meet a particular requirement is proposed. Author (NSA)

N68-14054# West Virginia Univ., Morgantown. Dept. of Physics.
VOLUME MAGNETOSTRICTION IN FERROMAGNETIC MATERIALS Final Report
Arthur S. Pavlovic 30 Sep. 1967 9 p refs
(Contract AT(40-1)-2839)
(ORO-2839-13) CFSTI: HC $3.00/MF $0.65

A brief summary is presented of work on the determination of the anisotropic magnetostriction constants, the forced anisotropic magnetostriction constants, and the forced volume magnetostriction for single crystals of Gd, Fe, Ni, Ni–Cu alloys, Co, and a Co–8% Fe alloy from 77°K to as high as 900°K (depending on the material) and in magnetic fields up to 21 kOe (depending on the material). Detailed results are reported in published and to-be-published papers; a list of these papers is included. NSA

N68-14087# Atomics International, Canoga Park, Calif.
BIAXIAL STRESS-RUPTURE PROPERTIES OF AUSTENITIC STAINLESS STEELS IN ZIRCONIUM-GETTERED SODIUM
W. T. Lee 1 Oct. 1967 40 p refs
(Contract AT(04-3)-701)
(NAA-SR-12353) CFSTI: HC $3.00/MF $0.65

The effect of a liquid metal environment upon the creep rupture of austenitic stainless steel was studied. Type 304 stainless steel containing 10 to 15% cold-work was tested in zirconium-gettered high purity sodium at 1300 and 1400°C for periods up to 1000 hr. Annealed Type 316 stainless steel was tested in zirconium-gettered high purity sodium at 1350°F for periods up to 1000 hr. For both austenitic stainless steels, the short-term rupture strength and rupture life of thin-wall tubing were found to be significantly lower in an environment of zirconium-gettered sodium than when tested in an atmosphere of helium. In the presence of sodium, the zirconium foil (inserted in the retort for oxygen-gettering) decarburized the stainless steel samples, thus reducing the stress-rupture strength and rupture life of the tubing. Recovery processes in the cold-worked Type 304 stainless steel specimens probably had an effect on the stress-rupture behavior. The formation of sigma phase was also detected, and is attributed to decarburization and the presence of cold-work. Author (NSA)

N68-14099# Rensselaer Polytechnic Inst., Troy, N. Y.
DENDRITE GROWTH IN SUPER COOLED METALS Final Report

Wylie J. Childs, E. J. Schneider, Peter S. Rudaw, and John N. Mushovic Aug. 1967 63 p refs
(Contract AT(30-1)-3004)
(RPI-3004-5) CFSTI: HC $3.00/MF $0.65

Three different aspects of dendrite growth investigations are presented in separate sections. Results and discussions are presented for experimental and theoretical studies on (1) the velocity of dendrite growth in Bi and several Bi alloys, (2) crystal growth and morphology in supercooled Bi–Cd and Bi–Sb alloys, and (3) the effect of supercooling on the dendrite morphology of Ni. NSA

N68-14102 United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
THE ROLE OF THE STRUCTURAL FACTOR IN THE SOLUTION OF THE PROBLEM OF STRENGTH OF METALS AND ALLOYS DESIGNED FOR SERVICE AT HIGH TEMPERATURES
M. G. Lozinskii Sep. 1966 18 p refs Transl. into ENGLISH from the book "Protsessy Uprochneniya Detalei Mashin" Moscow, Izd. Nauka, 1964 p 14–26
(AERE-TRANS-1072) HMSO: 3s

Procedures for increasing the strength of metals and alloys are discussed, with attention focused on the heat, mechanical, and thermomechanical treatments used to produce the required structural state in the material for a given service condition. Details are given on a procedure which combines hot plastic deformation, with reduction in area of the order of 20% to 25% and at temperatures above the recrystallization temperature, with subsequent rapid cooling (quenching). Aging treatments cause the precipitation of the hardening-phase particles. The method is based on the achievement of recrystallization-free hot work-hardening (RFHW). Consideration is given to the role of the structural factor in increasing the high temperature strength properties of materials subjected to RFHW. Analytical data indicate that the specific fine crystalline structure of nickel alloy developed during hardening by the RFHW method does not basically influence hardening, but rather helps it to retain properties acquired during high temperature deformation. M.G.J.

N68-14109# Bureau of Mines, Rolla, Mo.
MAGNETIC SUSCEPTIBILITY OF GROUP 4B, 5B, AND 6B METAL-BEARING MINERALS
H. E. Powell and Lee N. Ballard Feb. 1968 13 p refs
(BM-IC-8360)

The magnetic susceptibilities of 57 minerals containing titanium, zirconium, vanadium, columbium, tantalum, chromium, molybdenum, and tungsten were determined. The source and petrographic analysis of each sample are given. Included are values for isomorphous series of minerals showing wide ranges of composition and for a few high-purity synthetic minerals. Author

N68-14117# Societe d'Etudes, de Recherches et d'Applications pour l'Industrie, Brussels (Belgium).
CORROSION OF CARBON STEELS AND STAINLESS STEEL IN PRESSURIZED WATER AT HIGH TEMPERATURES Special Report No. 9
M. Warzee, C. Sonnen, and Ph. Berge 6 Jul. 1967 40 p refs
(Contract EURATOM-087-1-TEEB (RD))
(EURAEC-1896; EUR-3388) CFSTI: HC $3.00/MF $0.65

A carbon steel grade and two stainless steel grades, AISI 410 and AISI 304, were submitted to static and dynamic corrosion tests in pressurized water at 200 to 350°C. The effects of renewal and circulation of water, surface state of the metal, pH, and oxygen content of the solution were also examined. The oxidation mechanism of steels in high temperature pressurized water was investigated. It may be observed that the oxides formed in this medium, either on Cr or Cr–Ni alloyed steels or on unalloyed steels, appear to be formed of a double layer; the outer layer may in magnetite, whatever the steel grade, and develop from ferrous hydroxide in solution. The protective character of this external layer plays an important part in the corrosion kinetics of steels in water. The most severe corrosion cases were observed under dynamic conditions, in constantly purified water at pH 7. Author (NSA)

N68-14125 Lockheed Missiles and Space Co., Sunnyvale, Calif.
MECHANISM OF HIGH-TEMPERATURE CREEP OF METALS WITH HIGH STACKING-FAULT ENERGY
V. A. Yanushevich and L. I. Ivanov [1967] 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 176, no. 2, 1967 p 312–314

Basic characteristics of high temperature creep of metals with high stacking-fault energy with either a close packed or a body centered lattice are discussed. It is shown that the fundamental criteria of the creep mechanism are: (1) the presence of a cellular dislocation configuration; (2) the absence of a third stage of creep which is not due to the formation of necks; (3) the creep rate is slightly dependent on the sub-grain size but responsive to the state of the boundaries; (4) the exponent of the power dependence of the creep rate on the stress ≥ 3; and (5) the creep activation energy correspondent to the self diffusion activation energy. S.C.W.

N68-14134# Iowa State Univ. of Science and Technology, Ames.
YTTRIUM–CARBON PHASE SYSTEM
Wayne Marvin Paulson (M.S. Thesis) Aug. 1967 35 p refs
(Contract W-7405-ENG-82)
(IS-T-193) CFSTI: HC $3.00/MF $0.65

A Y–C phase diagram has been proposed based on thermal, metallographic and X-ray data. The solubility of C in Y increases with increasing temperature to 9.4a/oC at 1500°C. A peritectic occurs at 1558°C and 11a/oC and a peritectoid occurs at 1510°C and 10a/oC. The fcc γ phase melts congruently at 2000°C and 30a/oC and transforms to an ordered γ' phase below 1100°C at 33.3a/oC. A minimum was found in the solidus at 1805°C and 54a/oC. The bct YC_2 transforms to a fcc structure at 1330°C and melts congruently at 2415°C. A miscibility gap with a critical point at 1644°C and 58a/oC was found between γ and YC_2. The solid solution phases δ lies within the miscibility gap and transforms to ϵ at about 1355°C and 57a/oC. A limiting eutectoid occurs at 1320°C and 64a/oC and a YC_2–C eutectic horizontal was found at 2300°C. Alloys between 48a/oC and 62a/oC which were quenched from temperatures above the miscibility gap undergo a shear transformation to a metastable phase. Author (NSA)

N68-14135*# Aluminum Co. of America, New Kensington, Pa. Physical Metallurgy Div.
DEVELOPMENT OF A HIGH STRENGTH ALUMINUM ALLOY, READILY WELDABLE IN PLATE THICKNESSES, AND SUITABLE FOR APPLICATION AT −423 F (−253 C) Final Report, Jun. 28, 1963–Jun. 30, 1967
R. W. Westerlund, W. A. Anderson, and H. Y. Hunsicker 13 Oct. 1967 242 p refs
(Contract NAS8-5452)
(NASA-CR-61423) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The effects of composition and thermal treatment on the strength, notch-toughness, corrosion resistance and weld properties of X2021 and X7007 were determined. The nominal composition of X2021 is 6.3% Cu, .15% Cd, .05% Sn, .30% Mn, .18% Zr, .10% V and .06% Ti. The notch-toughness of X2021 at room

temperature is lower than that of some other aluminum alloys of similar strength. In the as-welded condition, weldments are susceptible to stress-corrosion cracking when stressed to 75% of the yield strength or more. In summary, alloy X2021 appears to be a significant improvement in high-strength, weldable aluminum alloys. The nominal composition of X7007 is 6.5% Zn, 1.8% Mg, .20% Mn, .12% Cr, .12% Zr, .10% Cu and .04% Ti. Alloy X7007 has good stress-corrosion resistance in the long transverse and longitudinal directions but is susceptible to stress-corrosion cracking in the short-transverse direction at stress levels as low as 25% of the yield strength. Weld tensile strengths are among the highest observed for aluminum weldments. Weld ductility is acceptable at room temperature and cryogenic temperatures. Author

N68-14192# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
CRACK PROPAGATION CHARACTERISTICS OF ZR-2.5 WT % NB ALLOY TUBING
P. J. Pankaskie Oct. 1967 33 p refs
(Contract AT(45-1)-1830)
(BNWL-560) CFSTI: HC$3.00/MF$0.65

The crack propagation behavior of Zr–2.5 wt % Nb alloy tubing, as determined from tests using milled slots as stress concentrators, is not significantly altered by cold working or heat treatments from room temperature to 300°C. When hydrided to 250 to 300 ppM of hydrogen, the fracture strength of a defected tube is generally reduced and its crack propagating behavior tends to be less predictable. Fatigue testing of tubes in the tension-tension mode by cyclic internal pressurization at peak cyclic hoop stresses of about one-fifth of ultimate hoop strength was continued until fatigue crack growth and catastrophic failure occurred. Under these loading conditions, leakage through a fatigue crack is likely to occur when the fatigue crack dimensions are appreciably smaller than the critical size for catastrophic failure. Data obtained suggest that the critical crack length for catastrophic failure may diminish with increasing amounts of prior fatigue damage. Author (NSA)

N68-14226# California Univ., Berkeley. Lawrence Radiation Lab.
RESISTOMETRIC OBSERVATION OF THE ANNEALING CHARACTERISTICS OF A TENSILE LOADED Cu–Al ALLOY
Ronald Paul Malatesta (M.D. Thesis) Sep. 1967 25 p refs
(Contract W-7405-ENG-48)
(UCRL-17799) CFSTI: HC$3.00/MF$0.65

A highly sensitive resistance measurement apparatus was set up to observe the effect on the electrical resistance of alloying Cu with Al and to observe recovery at low temperatures after cold work. The electrical resistivity ρ_0 was shown to be proportional to the square of the scattering charge z of the alloying element. An increase in resistance was detected in specimens annealed at 90°K and 113°K. Author (NSA)

N68-14233# Societe Etudes, de Recherches et d'Applications pour l'Industrie, Brussels (Belgium).
INFLUENCE OF SURFACE TREATMENT ON THE CORROSION OF TWO ZIRCONIUM ALLOYS IN HIGH-TEMPERATURE PRESSURED WATER AND SUPER-HEATED STEAM Special Report No. 7
M. Warzee, C. Sonne, and Ph. Berge 6 Jul. 1967 26 p refs
(Contract EURATOM-087-1-TEEB (RD))
(EURAEC-1894; EUR-3388) CFSTI: HC$3.00/MF$0.65

The effects of surface treatment on the corrosion of zirconium alloys in high temperature water and steam were examined at 300 to 450°C, over relatively long periods of time. It is concluded that, under such conditions, the effects of surface treatment on the behavior of Zircaloy 2 are secondary. In the case of Zirconium–2 Chromium–0.16 Iron alloys in superheated steam at 450°C and 70 kg/cm^2, it seems advantageous to prepare the surfaces by electropolishing. Such treatment reduces the corrosion rate in the post-transition zone; it has no effect on the quantity of hydrogen picked up, however. Deep surface work-hardening was found to be most unfavorable in this respect. Author (NSA)

N68-14355# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF STRUCTURAL CHANGES IN HIGH ALLOY FERRITE AUSTENITIC STEELS [ISSLEDOVANIYE STRUKTURNYKH IZMENENIY V VYSOKOLEGIROVANNYKH FERRITO AUSTENITNYKH STALYAKH]
Sie-si-san and J. Cadek 5 Sep. 1967 51 p refs Transl. into ENGLISH from Russian Presented at Symp. on Stainless Steels, Prague, 10–13 Sep. 1961 p 140–180
(FTD-MT-66-09; AD-662212)

Research was carried out with steel of the following composition: 0.16% C; 0.24% Mn; 0.26% Si; with steel 12.07% Cr; 8.07% Mo; 0.013 N, and with steel 2L with a content of 0.28% C; 0.17% Mn; 0.32% Si; 11.87% Cr; 8.09% Mo; 0.18% N. The work was carried out with the use of metallographic analysis, electrolytic isolation of the dispersion phases of X-ray and micro-chemical analysis, measurement of microhardness of delta ferrite and austenite and electronic microscopy. The effort concentrated on the study of structural changes during heating-up and cooling-down and during tempering in the region of temperatures of 500-800C and on the research on the isothemic desintegration of delta ferrite at temperatures of 800-1100C. The paper also comments on the determination of the activation energy of hardening processes in delta ferrite and austenite during tempering. The results of the research show the behaviour of delta ferrite during heating-up and cooling-down, the course of the delta - eutectoid reaction, the precipitation of carbides and intermetallic phases and the process of the de-stabilization and stabilization of austenite. TAB

N68-14377# Sandia Corp., Albuquerque, N. Mex. Aerospace Nuclear Safety Dept.
EMITTANCE VALUES OF HAYNES-25 FOR A SELECTED REENTRY ENVIRONMENT
J. E. Deveney Aug. 1967 41 p refs Sponsored by AEC
(SC-RR-66-576) CFSTI: HC$3.00/MF$0.65

Measurements of total normal and total hemispherical emissivities were performed on specimens of Haynes-25 having various thicknesses of oxide. This program was undertaken to develop emissivity values for use in Aerospace Nuclear Safety reentry analyses where the oxide is developing during reentry. Author (NSA)

N68-14429# Iowa State Univ. of Science and Technology, Ames.
EXPERIMENTAL STUDIES OF PRISMATIC CROSS-SLIP OF DISLOCATIONS IN THE VICINITY OF COHERENT STRAINED PRECIPITATIONS [EXPERIMENTELLE UNTERSUCHUNGEN DER PRISMATISCHEN QUERGLEITUNG VON VERSETZUNGEN IN DER UMGEBUNG VON KOHARENTEN VERSPANNTEN AUSSCHEIDUNGEN]
H. Gleiter Jul. 1967 9 p refs Transl. into ENGLISH from Acta Met., v. 15, p 1223–1228
(IS-TRANS-72) CFSTI: HC$3.00/MF$0.65

The experimental research which was carried out to test the proposed Cu–Co (3.12 at. % Co) and Ni–Si (12 at. % Si) alloy mechanism is presented. These alloys contained spherical coherent

precipitations with a radially-symmetrical deformation field, and they were therefore suitable for testing the theory for movement of dislocations. Author (NSA)

N68-14446 Mitsubishi Heavy Industries, Ltd., Tokyo (Japan).
CHARACTERISTICS OF 9% NICKEL STEEL FOR LOW TEMPERATURE SERVICE
Hiroshi Susukida (Kobe Tech. Inst.), Tomozumi Ando (Kobe Tech. Ins.), and Ichiro Tsuji (Kobe Tech. Inst.) Oct. 1967 14 p refs
(MTB-010053)

The authors have investigated on the low temperature mechanical properties, notch toughness, heat treatment and workability of ten kinds of 9% nickel steel, which is now used as a standard material for cryogenic vessels for liquefied gas storage and transportation with the following results: (1) Their tensile and fatigue strength at low temperatures down to −196°C were higher than their values at room temperature. Their elongation and reduction of area showed little difference even at −196°C from their respective values at room temperature. In the Charpy V impact test, no remarkable transition phenomenon was observed till temperature fell to −196°C, and in the drop-weight test and ESSO test there was not initiation of brittle fracture, nor its propagation. From these results, it was confirmed that 9% nickel steel can be safely used at the LMG temperature (−162°C). (2) The effects of heat treatment, cold working, hot working and long-term low temperature holding on the notch toughness of the steel were examined and as a result, fundamental data which are useful for the manufacture of cryogenic vessels were obtained. Author

N68-14480# Societe d'Etudes, de Recherches et d'Applications pour l'Industrie, Brussels (Belgium).
CORROSION OF STAINLESS STEEL AND HIGH NICKEL CONTENT ALLOYS IN HIGH-TEMPERATURE SUPERHEATED STEAM
M. Warzee, C. Sonnen, J. Cremer, and Ph. Berge (EURATOM, Brussels) 6 Jul. 1967 74 p refs *Its* Special Rept. No. 8
(Contract EURATOM-087-1-TEEB (RD))
(EURAEC-1895; EUR-3387) CFSTI: HC$3.00/MF$0.65

A series of Fe–Ni–Cr alloys have been subjected to static corrosion tests in steam, at 500 to 700°C and 70 kg/cm^2. When the surface structure of these alloys is normally crystallized, corrosion is generally inversely related to the Ni content of the alloy. It was found that a special grade of austenitic steel, containing 0.2% C, 1.5% Si and 4% W, is much less affected by corrosion in steam at 600 or 700°C than the conventional 18/10 grades. The behavior of these alloys in superheated steam, depends more on the absence of local corrosion at grain boundaries and on the homogeneity of the alloy subjacent to the oxide layer. Heterogeneities at the grain boundaries, that seem of little importance when the corrosion process goes on in the absence of mechanical stresses, develop into a deep intergranular attack when the corrosion process occurs together with stresses such as those due to the steam pressure exerted inside tubular samples. Author (NSA)

N68-14481# California Univ., Berkeley. Lawrence Radiation Lab.
QUANTITATIVE INVESTIGATION OF STRAIN INDUCED STRENGTHENING IN STEEL
Bertrand de Miramon (M.S. Thesis) Sep. 1967 48 p refs
(Contract W-7405-ENG-48)
(UCRL-17849) CFSTI: HC$3.00/MF$0.65

Effects of strain-induced austenite → martensite transformation on the mechanical properties and especially on the ductility of some metastable austenitic steels were investigated. The steels investigated were a new class of high nitrogen steels having yield strengths above 200,000 psi with 20 to 40% elongation. The results emphasize the important role of the austenite → martensite transformation in improving the ductility by preventing early necking. The austenite → martensite transformation was detected by a magnetic method. It was assumed that the saturation induction (B_s) was proportional to the amount of magnetic phase (martensite). The proportion of martensite in each specimen was measured during pulling using a permeameter attached to an Instron testing machine. The tests showed that martensite forms immediately after the yield point in a region of the specimen which is plastically deformed. Some static measurements were also made on small portions cut from the tensile specimen. These measurements indicated that the austenite → martensite transformation seems to occur only in the plastic region which traverses the specimen. Finally, results of a few continuous (but nonquantitative) tests indicated that serrations observed in some tensile curves can be correlated with discontinuities in the martensite transformation. Author (NSA)

N68-14487# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Physical and Engineering Metallurgy.
BINARY MULTIPHASE DIFFUSION IN METALLIC SYSTEMS, PART 1 Progress Report, Feb. 1–Oct. 31, 1967
Louis S. Castleman, J. Lyttle, and P. Dembowski 31 Oct. 1967 24 p refs
(Contract AT(30-1)-3814)
(NYO-3814-1, Pt. 1; Pr-1) CFSTI: HC$3.00/MF$0.65

An investigation is underway to determine the origin, structure, and morphology of non-planar interfaces in binary multiphase diffusing systems. Effort has largely been concentrated on a study of the aluminum–antimony system. Although the investigation is not yet complete, the following conclusions appear to be warranted. It has been confirmed that the intermediate phase, AlSb, forms at the interface of aluminum–antimony diffusion couples and grows in a highly irregular fashion during isothermal diffusion at 600°C. The phenomenon does not appear to be due primarily to the scarcity of suitable sites for the nucleation of AlSb at the aluminum–antimony interface at the start of diffusion. Preferential growth of the AlSb layer along grain boundaries of aluminum and antimony owing to grain boundary diffusion does not play a significant role. Tentatively, it appears that the growth of the intermediate phase, InSb, in the indium–antimony system is similar to that of AlSb in the aluminum–antimony system. The results suggest that existing theory is inadequate to explain irregular growth of intermediate phases in binary diffusing systems and that the crystal structure of the intermediate phases may be an important factor. Author (NSA)

N68-14488# Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center.
STATIC AND SLIDING CONTACT BEHAVIOR OF MATERIALS IN SODIUM ENVIRONMENTS AT ELEVATED TEMPERATURES
W. J. Freede, L. Newcomb, and R. S. Kennedy 29 Sep. 1967 64 p refs
(Contract AT(04-3)-700)
(NAA-SR-12446) CFSTI: HC$3.00/MF$0.65

Tests are in progress to determine static and sliding contact behavior characteristics of selected candidate material combinations in liquid and vapor sodium environments with inert cover gas at elevated temperatures. Most static contact tests showed that self-welding of materials in sodium tended to progress with time at environment. Composition and hot hardness of specimens affected results more than did variations in sodium environment. Sliding contact tests indicated that metals should be heat-treated to their maximum practical hardness. Material combinations of hard vs hard

tended to be more wear-resistant than hard vs soft. Material buildup instead of wear on sliding contact surfaces was observed in a number of tests. Substantial differences in wear behavior were observed in materials of different compositions with somewhat similar hot hardness characteristics. Author (NSA)

N68-14508* Boeing Co., Seattle, Wash.
INVESTIGATION OF FRACTURE OF 6 AL–4V TITANIUM IN N_2O_4
W. P. Haese 7 Dec. 1965 77 p refs
(Contract NAS1-3800)
(NASA-CR-66524; D2-24057-1) CFSTI: $3.00 CSCL 11F

A program, using applied fracture mechanics, is presented to determine: (1) critical flaw sizes required for lunar orbiter 6AL–4V N_2O_4 tank fracture, (2) if small initial flaws in the tank are likely to grow to critical size during tank operational life, and (3) what changes to the tank operating stress levels, proof test, inspection, material processing or actual tank materials are required to assure adequate reliability. Author

N68-14509# Aerospace Corp., El Segundo, Calif. Lab. Operations.
STRESS AND CHEMICAL CORROSION OF TITANIUM ALLOY IN FREON ENVIRONMENTS
Kenneth T. Kamber, Ernest G. Kendall, and Le Roy Schieler Oct. 1967 41 p ref
(Contract F04695-67-C-0158)
(TR-0158(3250-10)-5; SAMSO-TR-67-62; AD-662604)

The stress corrosion cracking tendency of Ti–6Al–4V alloy was investigated in environments of commercial freon TF with and without 0.3 ppm Cl2 Gas. Both welded and nonwelded titanium alloy specimens were stressed to 80 percent of the yield strength (0.2 percent offset) for 72-hr exposures to the freon TF environment. Mechanical property measurements and metallographic analysis were performed on the titanium alloy specimens before and after exposure. There was no evidence that freon TF, with or without 0.3 ppm Cl2, would cause stress corrosion cracking of Ti–6Al–4V alloy. Exposure of the stressed titanium to freon TF for 72 hr resulted in a slight increase in tensile strength. This increase is believed to be due to a creep hardening phenomenon rather than any reaction between the titanium and the freon TF. Author (TAB)

N68-14517# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
STRESS CORROSION AND HYDROGEN EMBRITTLEMENT PROPERTIES OF 17-4 PH IN 600°F WATERS
Henry Suss Apr. 1967 64 p ref
(Contract W-31-109-ENG-52)
(KAPL-M-6580) CFSTI: HC $3.00/MF $0.65

Stressed 17–4 PH specimens were exposed for 700 days to 600° F hydrogen-ammoniated water and to (cyclic) hydrogen-ammoniated and aerated water. The susceptibility of the alloy aged at 900°F to stress corrosion in 600°F aerated water was confirmed. No such susceptibility was evident in the hydrogen-ammoniated water. The susceptibility of the 900°F aged material to hydrogen embrittlement in both water conditions was shown. This susceptibility was evident only with a high applied stress of 165,000 psi for air melt and 100,000 psi for consumable electrode melt materials. No stress corrosion attack of the alloy aged at 1025°F or 1100°F in either environment was indicated. The one failure of each 1025°F aged and 1100°F aged, with applied stresses close to yield strength, has been attributed tentatively to hydrogen embrittlement. The consumable electrode heats appeared more susceptible to hydrogen embrittlement than air melt material. The alloy in the three aged conditions (900°F, 1025°F and 1100°F) was subject to secondary aging resulting in increase in hardness up to 4 R_c units and 20,000 psi in tensile strength—with some loss in ductility. Author (NSA)

N68-14520 Commissariat a l'Energie Atomique, Paris (France).
CONDITIONS FOR THE FLAKING OF URANIUM AND A URANIUM-MOLYBDENUM ALLOY [CONDITIONS D'ECAILLAGE DE L'URANIUM ET D'UN ALLIAGE URANIUM-MOLYBDENE]
J. Vacellier, G. Verdes, and J. Legrand 15 Sep. 1967 7 p refs In FRENCH Presented at High Dyn. Pressure Symp., Paris, 11–15 Sep. 1967

Both a mechanical and a metallurgical point of view are taken during the examination of conditions that lead to the flaking of uranium and uranium alloy containing 1.5% molybdenum. Methods that permit the measurement of creep rupture are reported, along with some calculations and some micrographic observations of flaking. Results based on an equation of state in tension indicate creep rupture values between 200 and 250 kb for speeds of relaxation on the order of 0.2 Mb/μs, a value that is much larger than that obtained with the equation of state alone. Theoretical considerations tend to justify this value. Transl. by M.W.R.

N68-14543# Los Alamos Scientific Lab., N. Mex.
FORMATION OF CARBIDE SURFACES ON TANTALUM AND TANTALUM–TUNGSTEN ALLOYS
N. H. Krikorian, T. C. Wallace, R. Krohn, and M. G. Bowman [1967] 20 p refs Presented at the 3d Intern. Symp. on High Temp. Technol., Pacific Grove, Calif.
(Contract W-7405-ENG-36)
(LA-DC-8803; CONF-670935-5) CFSTI: HC $3.00/MF $0.65

The formation of carbide layers on tantalum and tantalum–tungsten alloys based on layer growth measurements is discussed. Information is included on fundamental processes of carbon diffusion into tantalum at 1200 to 2800°C and the application of these fundamental findings. NSA

N68-14576* Battelle Memorial Inst., Columbus, Ohio.
DETERMINATION OF FLAW GROWTH CHARACTERISTICS OF TI–6AL–4V SHEET IN THE SOLUTION-TREATED AND AGED CONDITION Final Report
David W. Hoeppner, Donald E. Pettit, Charles E. Feddersen, and Walter S. Hyler 1 Jan. 1968 201 p refs
(Contract NAS9-6969)
(NASA-CR-65811) CFSTI: $3.00 CSCL 11F

The feasibility of employing cryogenic proof testing to screen out small defects in LM tankage was investigated. The defect growth and fracture characteristics were studied in parent (unwelded) and welded sheet material. The results of the study indicate that cryogenic proof testing will screen smaller size defects than proof testing at ambient conditions. However, some unusual crack growth behavior during the proof test simulation suggests that some further study be made of stress and time duration effects. Details of the results and experimental program are presented. Author

N68-14588# California Univ., Berkeley. Lawrence Radiation Lab.
EFFECT OF INITIAL DISLOCATION DENSITY ON SINGLE SLIP STRAIN HARDENING OF COPPER
Jack Washburn and Gollapudi Murty Aug. 1967 33 p Presented at the Intern. Conf. on the Strength of Metals and Alloys, Tokyo, 4–8 Sep. 1967 Submitted for publication
(Contract W-7405-ENG-48)
(UCRL-17774; CONF-670909-8) CFSTI: HC $3.00/MF $0.65

Copper crystals in which different dislocation densities were introduced by multiple slip were subsequently deformed in tension in single slip. In all cases three stages were found on the stress

strain curves. Detailed observations of surface slip markings were carried out on all specimens. It was shown that Stage I in prestrained specimens was due to progressive deformation starting at points of stress concentration and propagating through the gage length. Stress strain curves and shear strain distribution were found to change in a regular way with initial dislocation density; the results from as-grown specimens are seen as part of a homologous series which includes all of the results from prestrained specimens. It is suggested that Stage I in pure copper is at least partly due to unavoidable prestrains during cooling, handling, and pre-yield loading. Linking of slip clusters to form groups that grow entirely across the specimen was found during all stages of deformation, even for as-grown crystals. Author (NSA)

N68-14598# Columbia Univ., New York.
[NATURE OF RADIATION DAMAGE] Final Report
[1967] 4 p refs
(Contract AT(30-1)-3551)
(CU-3551-9) CFSTI: HC$3.00/MF$0.65

The nature of metal radiation damage was studied with a field ion microscope and correlated with the mechanical properties, such as yield stress and annealing characteristics of the irradiated specimens. A list of publications and discussions on the subject is included. NSA

N68-14642* Florida Univ., Gainesville.
INTERNAL DEFORMATION AND FRACTURE OF SECOND ORDER [1011]–[1012] TWINS IN MAGNESIUM
W. H. Hartt and R. E. Reed-Hill [1965] 37 p refs
(Grant NsG-542)
(NASA-CR-91810) CFSTI: $3.00 CSCL 11F

High purity magnesium single crystals, oriented with basal plane parallel to stress axis, were deformed in tension at room temperature so as to form second order $|10\bar{1}1|$–$|10\bar{1}2|$ twins. Investigation by optical and replica electron microscopy revealed that these twins can support very large internal strains approaching 1000 percent and that fracture follows as a direct consequence of these strains. At low strains the basal plane within $|10\bar{1}1|$–$|10\bar{1}2|$ twins was observed to rotate with increasing deformation until it became approximately parallel to the twin boundaries. Deformation markings were also noted in the twin bands that cannot be described in terms of slip on previously observed systems. The fracture associated with these twins is thought to initiate by formation of voids at the twin boundaries that grow into microcracks, with ultimate fracture occurring by tearing of the interconnecting regions. Author

N68-14660# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.
THE METASTABILITY OF GOLD-ANTIMONY PHASES PREPARED BY SPLAT COOLING
A. K. Jena, B. C. Giessen, M. B. Bever, and N. J. Grant 15 Nov. 1967 18 p refs
(Contract Nonr-3963(19))
(TR-5; AD-662408)

The metastable gold-antimony phases zeta containing 15.0 at. pct Sb and pi containing 76.6 pct Sb were prepared by splat cooling. The heats of formation of these phases were measured by solution calorimetry and their free energies of formation were estimated. An analysis of the free energies of the relevant phases leads to the following conclusions. (1) The phases zeta and pi are unstable at all temperatures. (2) Liquid alloys containing 15.0 pct and 76.6 pct Sb, respectively, must be undercooled by at least 150 and 200K for the phases zeta and pi to form. (3) The temperature below which the pi phase can form (600K) is about 250K lower than the temperature below which the zeta phase can form. (4) Although the free energies indicate that the pi phase is more unstable than the zeta phase, the calculated degrees of undercooling required and the calculated temperature of formation of the two phases indicate that the pi phase is less difficult to produce by splat cooling than the zeta phase. This is in agreement with experimental observations. Author (TAB)

N68-14721 National Bureau of Standards, Boulder, Colo. Inst. for Materials Research.
LOW TEMPERATURE MECHANICAL PROPERTIES OF COPPER AND SELECTED COPPER ALLOYS: A COMPILATION FROM THE LITERATURE
Richard P. Reed and Ritchie P. Mikesell 1 Dec. 1967 165 p refs
(NBS-MONOGRAPH-101) GPO: $2.75

In the past 60 years considerable data has accumulated concerning the mechanical properties of copper and its alloys. It was felt that there was a great need to adequately document these results in one publication. Therefore a unique type of compilation is presented. The compilation is divided into four parts. The first section is intended for quick reference use for those who are interested in average values. The second section includes data from most of the investigators who have published results on the mechanical properties of copper and its alloys. The third section is composed of tables classifying the investigations which were not included in section two. These usually involve investigations in which data were obtained only at one temperature, such as room temperature. The fourth section lists, in alphabetical order, all references used. Author

N68-14742# California Univ., Berkeley. Lawrence Radiation Lab.
STRENGTH AND DUCTILITY OF METASTABLE AUSTENITIC STEELS AS A FUNCTION OF COMPOSITION AND TEST TEMPERATURES
Govind Ram Chanani (M.S. Thesis) Sep. 1967 74 p refs
(Contract W-7405-ENG-48)
(UCRL-17805) CFSTI: HC$3.00/MF$0.65

The combined and individual effects of composition, test temperature, and temperature of deformation on the tensile properties and strain-hardening characteristics of metastable austenitic steels were investigated. The results indicate unusual combinations of strength and ductility for the steels in a certain carbon range after suitable thermomechanical processing. The strength and ductility were retained at −196°C to 100°C. However, at 200°C, which is above M_D, the material exhibited lower ductility. A CDC 6600 computer (Fortran IV) was used to determine the true stress–true strain relationship and strain hardening exponent. Certain thermo-mechanical treatments produced steels having yield strengths in the range of 200,000 to 300,000 psi with 30 to 20% elongation, respectively. The improved ductility for these steels compared to conventional high strength steels is attributed to the martensitic transformation occurring during testing which is thought to inhibit incipient necking. Author (NSA)

N68-14745# Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering.
EFFECT OF ANNEALING ON THE SUBSTRUCTURE OF COLD WORKED FCC METALS AND ALLOYS Technical Progress Report, 1 Sep. 1966–1 Sep. 1967
D. E. Mikkola, J. W. Kirby, and A. L. Ward 1 Sep. 1967 33 p refs

(Contract AT(11-1)-1431)
(COO-1431-3; TPR-3) CFSTI: HC $3.00/MF $0.65

The annealing behavior of α-Cu-Ge solid solutions and the ordered alloy Cu_3Au is examined to relate the changes in substructure of cold worked fcc metals and alloys to physical properties. X-ray line broadening and peak shifts are used to examine the substructure of the alloys. NSA

N68-14776# Harvard Univ., Cambridge, Mass. Engineering and Applied Physics Div.
EVIDENCE OF A GLASS LIQUID TRANSITION IN A GOLD GERMANIUM SILICON ALLOY
H. S. Chen and D. Turnbull Nov. 1967 44 p refs
(Contract Nonr-1886(50))
(TR-13; AD-662652)

Gold rich (73-81 at % Au) alloys of gold-germanium-silicon were splat-cooled to an amorphous solid form. Thermal and rheological evidence of a glass-liquid transition in the Au sub 0.77 Ge sub 0.136 Si sub 0.094 alloys is reported. The transition was manifested thermally by an abrupt rise of 5.5 cal/gm. atom K in specific heat, C sub p, as the alloy was heated from 285 to 297K. Just above 297K C sub p starts to fall with increasing T on a reasonable extrapolation of the high-temperature C sub p-T relation of the liquid alloy. This thermal behavior could be repeated on the same sample after it had been carried through the transition and chilled again. The apparent glass transition temperature was increased by 1-3 degrees by increasing the heating rate by a factor of 16. The viscosity, Eta, of the amorphous alloy increases rapidly with falling temperature from 0.9 x 10 to the 9th power poise at 305 K to 1.4 x 10 to the 13th power poise at 285K and is described by the equation: Eta = 0.52 exp(1360/(T - 251.3)) poise. The steady isothermal viscosity is independent of stress over the range 3 to 140 Kg/sq cm. Our finding that abrupt temperature changes in the high viscosity regime shifts Eta rather little initially indicates that Eta depends primarily on configuration rather than temperature per se. Measurements of enthalpy and resistivity of the alloy in its various states are made. Author (TAB)

N68-14779 Societe d'Etudes, de Recherches et d'Applications pour l'Industrie, Brussels (Belgium).
CORROSION OF CARBON STEELS AND STAINLESS STEELS IN PRESSURIZED WATER AT HIGH TEMPERATURE [CORROSION DES ACIERS AU CARBONE ET DES ACIERS INOXYDABLES DANS L'EAU SOUS PRESSION A HAUTE TEMPERATURE]
M. Warzee, C. Sonnen, and Ph. Berge (EURATOM) EURATOM Oct. 1967 44 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-087-66-1-TEEB)
(EUR-3388.F; EURAEC-1896)

A carbon steel grade and two stainless steel grades have been submitted to static and dynamic corrosion tests in pressurized water, at temperatures ranging from 200 to 350°C. Apart from temperature, the influence of other parameters was investigated; these are: renewal and circulation of water, surface state of the metal, pH and oxygen content of the solution. The oxidation mechanism of steels in high temperature pressurized water has been investigated. One may observe that the oxides formed in this medium, either on Cr or Cr–Ni alloyed steels or on unalloyed steels, appear as formed of a double layer; the outer layer may in some cases be composed of scattered crystals. These crystals are magnetite, whatever the steel grade, and develop from ferrous hydroxide in solution. The protective character of this external layer plays an important part in the corrosion kinetic of steels in water. The influence of the various investigated parameters has in most cases been interpreted, by means of the characteristics of the external magnetite layer. The most severe corrosion cases have been observed under dynamic conditions, in constantly purified water at pH 7. The increase of the pH up to 10, diminishing considerably the solubility of ferrous hydroxide is favourable to deposition. The direct influence of temperature on the transformation of ferrous hydroxide into magnetic explains, in some cases anyhow, the fouling of fuel elements in PWR reactors. Author

N68-14780# Societe d'Etudes, de Recherche et d'Applications pour l'Industrie, Brussels (Beglium).
CORROSION OF STAINLESS STEELS AND NICKEL BASE ALLOYS IN SUPERHEATED STEAM AT HIGH TEMPERATURE
M. Warzee, C. Sonnen, J. Cremer, and Ph. Berge (EURATOM) Oct. 1967 78 p refs In FRENCH
(Contract EURATOM-087-66-1-TEEB)
(EUR-3387.F)

A series of Fe–Ni–Cr alloys have been submitted to static corrosion tests in high temperature steam, in the range 500–700°C, at 70 kg/cm^2. When the superficial structure of these alloys is normally crystallized, it appears that generalized corrosion is inversely related to the Ni content of the alloy. It could be demonstrated that heterogeneities at the grain boundaries, that seem of little importance when the corrosion process goes on in the absence of mechanical stresses develop into a deep intergranular attack when the corrosion process occurs together with stresses. When these alloys are superficially cold-worked prior to being submitted to superheated steam, integranular attack phenomena are of course avoided, and one does practically no more note the influence of the composition of the alloy upon the corrosion level which is very low. By extending to about one year the test duration, it has has been established that a cold-worked depth of several tens of a micron must be attained by the chosen machining process, or else the behaviour, with respect to oxidation, of the cold-worked alloys lowers itself after a more or less long period of time. Author

N68-14867 Martin Co., Denver, Colo.
THE SHOCK-HARDENING OF STRUCTURAL METALS
Henry E. Otto and Ritchie Mikesell *In its* Center for High Energy Forming Aug. 1967 p 117–158 refs (See N68-14861 05-15)

Results of mechanical property tests with various shock hardened alloys of iron, copper, and aluminum, are presented. Most of the data were obtained on plane wave loading of relatively thin sheets in which attenuation characteristics of the shock front are minimized. Chemical composition data of the various alloys measured are given. L.S.

N68-14868 Martin Co., Denver, Colo.
THE INHIBITION OF SHOCK TWINNING IN PRESTRAINED ARMCO IRON
S. Mahajan (Denver Univ.) *In its* Center for High Energy Forming Aug. 1967 p 159–176 refs (See N68-14861 05-15)

The formation of twins in prestrained Armco iron was investigated by optical metallography and transmission electron microscopy. The results indicate that shock twinning is suppressed in the presence of a substructure. For example, at 50 kbars the total length of twins in a unit area of a sample decreases from 1.51 cm^{-1} to 0.60 cm^{-1} as the amount of prestrain is increased to 20%. This inhibition of twinning is essentially the result of the lack of potential nucleation-sites for twins in prestrained samples. Propagation characteristics of a twin are not considerably affected by the presence of a substructure. Author

N68-14883# Sandia Corp., Albuquerque, N. Mex.
PARAMETRIC STUDY OF ION-PLATED ALUMINUM COATINGS ON URANIUM
R. D. Bland Sep. 1967 23 p refs
(SC-DR-67-709; TID-4500) CFSTI: HC $3.00/MF $0.65

Ion-plated Al coatings were found to provide excellent corrosion protection on unalloyed depleted U when exposed to an accelerated (100°C at 1 atmosphere H_2O vapor pressure) corrosion test. This study was undertaken to determine what process parameters influence the coating properties and to optimize processing conditions for maximum corrosion protection afforded to the U. The parameters which influence corrosion protection were: substrate precleaning, amount of contamination in the glow discharge, sputter cleaning voltage and pressure, filament contamination, deposition rate, and amount of diffusion, either during plating or in subsequent vacuum heat treatment. A diffusion layer consisting of U–Al intermetallic compounds is believed to provide the corrosion protection in this system. Author (NSA)

N68-14888*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TECHNIQUE FOR RECOVERY OF ALKALI-METAL REACTION PRODUCTS
Randall F. Gahn Washington Jan. 1968 11 p refs
(NASA-TN-D-4310) CFSTI: HC $3.00/MF $0.65 CSCL 07B

A procedure for the isolation and recovery of alkali-metal reaction products in an uncontaminated state is described. Separation of the reaction product from excess alkali metal is accomplished by vacuum distillation. All recovery operations are carried out in high-vacuum or inert gas atmospheres. Two typical examples of the application and reproducibility of the procedure are presented: (1) the recovery of potassium tantalate (K_3TaO_4) from the potassium–tantalum-oxygen reaction, and (2) the recovery of potassium monoxide (K_2O) from the potassium–oxygen reaction. Reaction products are identified by both X-ray diffraction 1nd chemical analysis. Author

N68-14920# United Aircraft Corp., Stratford, Conn.
EVALUATION OF TWO TITANIUM FORGING ALLOYS Final Report
Charles J. Matusovich Ft. Eustis, Va. Army Aviation Materiel Labs. Aug. 1967 89 p refs
(Contract DA-44-177-AMC-256(T))
(USAAVLABS-TR-67-43; AD-662700)

Ti-6Al-6V-2Sn and Ti-13V-11Cr-3Al (both solution heat-treated and aged) were evaluated. Both small-size specimens and full-size helicopter components were tested. Small-size specimens were tested for resistance to fatigue crack initiation, resistance to fatigue crack propagation, and fracture toughness. Fatigue crack initiation tests included tension-tension tests both of unnotched specimens and of joints. Helicopter main rotor cuffs were evaluated in fatigue crack initiation and fatigue crack propagation tests with expanded holes and with reamed holes. The titanium alloy cuff test results were compared to those for Ti-6Al-4V (annealed) and 4340 steel (heat-treated to a 125-ksi minimum ultimate tensile strength) cuffs and to small-size specimen tests. Tensile test data, chemical analysis and forging parameters are also presented. The crack initiation resistance of Ti-6Al-6V-2Sn was found to be superior to that of Ti-13V-11Cr-3Al. Axial tension-tension fatigue results showed 50% higher fatigue strengths for Ti-6Al-6V-2Sn than for Ti-13V-11Cr-3Al. Joint fatigue tests also showed higher strength values for the Ti-6Al-6V-2Sn alloy. Fracture toughness results were comparable for both alloys. Joint fatigue test evaluations were made for reamed, shot peened, and expanded holes. The highest fatigue strength values were associated with specimens having expanded holes. The Ti-6Al-6V-2Sn cuffs with both reamed and expanded cuff-to-spar attachment holes showed higher fatigue crack initiation strength values than those of the Ti-13V-11Cr-3Al. Author (TAB)

N68-14981# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DISTORTION OF THE CRYSTALLINE STRUCTURE AND DENSITY OF THE DISLOCATIONS IN MOLYBDENUM IN VARIOUS STAGES OF REFINEMENT AFTER FILING [ISKAZHENKYA KRISTALLICHESKOY STRUKTURY I PLOTNOST' DISLOKATSIY V MOLIBDENE RAZNOY STEPENI CHRISTOTY POSLE NAPILOVKI]
Ye. M. Savitskiy, A. A. Barbareko, and Tsu-ts'ung T'ao 26 May 1967 13 p refs Transl. into ENGLISH from the Publ. "Problemy Bol'shoy Metallurgii i Fizicheskoy Khimii Novykh Splavov" (Moscow), Izd-Vo Nauka, 1965 p 250–254
(FTD-HT-66-638; AD-662211)

The results of the computation of n and rho are presented. The mean-statistical number of dislocations n in the accumulation in industrial molybdenum amounts n = 4.7, for the alloy Mo+ 0.1% La, it is equal to n = 2.7, whereas for the refined molybdenum n = 1. Such an order of change in the value of n in the different specimens of molybdenum fully agrees with the change in its purity and plasticity of the molybdenum, the greater the number of dislocations in the accumulation will be. The density of the dislocations in all the cases lies within the limits 10 to the 11th power–10 to 12th power/sq cm, which corresponds with its typical value for metals in the cold-hardened state. The greater density of the dislocations in the refined molybdenum as compared with industrial molbydenum Mo+0.1% La is brought about by the greater plastic deformations in the filing. A comparative evaluation of the levels rho sub delta a/a and rho sub d enables one to draw an unambiguous conclusion relative to the different character of the interactions and distribution of the dislocations in molybdenum of different purity. TAB

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellents; and 32 Structural Mechanics.

N68-13937# Argonne National Lab., Ill.
ELECTRON-MICROSCOPIC STUDIES OF FUNDAMENTAL PHYSICAL AND CHEMICAL PROCESSES IN SINGLE CRYSTALS OF GRAPHITE
G. Montet, F. Festes, and G. Myers Jul. 1967 49 p refs
(Contract W-31-109-ENG-38)
(ANL-7352) CFSTI: HC $3.00/MF $0.65

Studies of processes occurring in single crystals of graphite as a result of certain physical and chemical changes used the etch-decoration technique for detection of defects in graphite by electron microscopy. Displacement energy in graphite, optical density and thickness of graphite lamellae, and reactions of gases with single crystals of graphite are discussed. NSA

N68-13961 Joint Publications Research Service, Washington, D. C.
GLASS FIBER REINFORCED PLASTICS

I. I. Porzhitskiy and B. S. L'vov 9 Jan. 1968 12 p Transl. into ENGLISH from Plasticheskiye Massy (Moscow), no. 11, 1967 p 48–52
(JPRS-43923) CFSTI: $3.00

The development of glass fiber reinforced plastics in the Soviet Union is traced from its pre-World War II inception. The impetus given to the industry by the continuing scale-up of production facilities is noted, and improved processing techniques are discussed. Marketable items are identified as glass fiber laminates, molding materials, reinforced thermoplastics, contact molding of large size articles, and tubular configurations. M.G.J.

N68-14000# Technische Univ., Berlin (West Germany). Inst. fuer Kerntechnik.
CONTRIBUTION OF THE INVESTIGATION OF THE VAPOR-PRESSURE BEHAVIOR OF MOLTEN OXIDES IN VIEW OF THEIR USE IN HIGH TEMPERATURE NUCLEAR REACTORS [BEITRAG ZUR UNTERSUCHUNG DES DAMPFDRUCKVERHALTENS SCHMELZFLUESSIGER OXIDE IM HINBLICK AUF IHRE VERWENDUNG IN HOCHTEMPERATUR-KERNSPALTREAKTOREN]
Bodo Gross Oct. 1966 144 p refs In GERMAN
(TUBIK-4)

In order to test the suitability of the molten oxides SiO_2, Al_2O_3, and ZrO_2 as solvents for UO_2 in a homogeneous high-temperature reactor, a method for measurement of the vapor and dissociation pressures of these oxides was developed. The measurement method was investigated theoretically and the research arrangement used is described. The individual oxides SiO_2, UO_2, ZrO_2, and Al_2O_3 and the binary systems UO_2–ZrO_2 and UO_2–SiO_2 were investigated. As thermodynamic data for the individual components were known from decomposition reactions, a comparison was made of the measured and calculated dissociation pressures. Author

N68-14048 United Kingdom Atomic Energy Authority, Harwell (England). Industrial Chemistry Branch.
PRELIMINARY INVESTIGATIONS INTO THE USE OF GLASS BEADS IN FIBREGLASS REINFORCED PLASTICS
H. Wells Jul. 1967 29 p refs
(AERE-R-5504) HMSO: 4s 6d

The effect of adding glass beads and powdered quartz to resins used for manufacturing fiberglass laminates is reported. Viscosity considerations make it practicable to use higher loadings of glass beads than powdered quartz, and there appears to be preliminary evidence that the shape of the filler can affect the mechanical properties of the resultant composite. Author

N68-14257* Utah Univ., Salt Lake City. Coll. of Engineering.
SOME PRELIMINARY MEASUREMENTS OF FREE RADICAL FORMATION IN POLYMERS UNDER STRESS
K. L. De Vries, D. K. Roylance, and M. L. Williams Nov. 1967 19 p refs Presented at the 6th ICRPG Working Group on Mech. Behavior, JPL, Pasadena, Calif., 6 Dec. 1967
(Grant NGR-45-003-037)
(NASA-CR-91804; UTEC-DO-67-026) CFSTI: $3.00 CSCL 11I

It is proposed to present some initial observations on the use of electron paramagnetic resonance to detect the number of free radicals formed in polymeric materials due to the application of tensile stress. A summary of pertinent theoretical background, including the pioneer work of Zhurkov will be followed by our initial results showing the signatures and decay rates obtained in two materials, drawn Nylon and Solithane 113, for three types of damage to the specimens—crushing, radiation, and stretching. Author

N68-14362# Naval Research Lab., Washington, D. C. Deep Sea Research Branch.
LONGTERM HYDROSTATIC TESTS OF SYNTACTIC FOAM
J. J. Gennari and H. E. Barnes 11 Oct. 1967 38 p
(NRL-6577; AD-662657)

Syntactic foam samples were tested in fresh water under pressures of 3000, 5000, and 10,000 psi at 2C and at room temperature (about 25C). The samples were 1-3/4-in.-diam, 6-in.-long solid cylinders. The long-term hydrostatic test results, presented here, indicate that the rate of water absorption continues almost linearly with exposure time. Based on the data presented at the present time the life expectancy (no longer buoyant) of a good grade of 42-lb/cu ft syntactic foam at 10,000 psig is estimated to be about 10 years. Author (TAB)

N68-14477 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
ESSENTIAL PARAMETERS FOR HIGH RESISTANCE OF REINFORCED RESINS [PARAMETRES ESSENTIELS CONDITIONNANT LA HAUTE RESISTANCE DES RESINES ARMEES]
Arthur Iablokoff 1967 26 p Presented at the Maritime and Aeron. Tech. Assoc., Paris, 24–27 Apr. 1967 In FRENCH
(ONERA-TP-468)

The high resistance of unidirectional composites depends upon the choice of the constituents for the armature and matrix phases. The interaction of these phases involves the display of a certain number of some essential parameters, which are reviewed in this note. Particular interest is shown in the elastomechanical equilibrium at the interface between the two phases which can be favorably influenced by the choice of proper constraints. This equilibrium results from the same characteristics that become dominant at the interface; and, although it is not possible to evaluate them by direct methods, they can be described in a detailed manner. Elastic interfaces can be seen and calculated in the same way. The detection and measurement of matrices in synthetic resins are also considered, including the variation of elastomechanical properties during postpolymerization and the particular role of contractions from polymerization orientation. Transl. by M.W.R.

N68-14510# European Atomic Energy Community, Ispra (Italy).
ELASTIC NEUTRON DIFFRACTION ANALYSIS OF A POWDER SAMPLE OF UC
M. Bonomo (Comitato Nazionale per l'Energia Nucl., Ispra (Italy)) and R. Colella Brussels Dec. 1967 12 p refs
(EUR-3655.E)

The neutron diffraction pattern of a powder of uranium monocarbide has been obtained by means of a triple axis spectrometer in conventional and elastic diffraction at room temperature. The atomic mean square displacements are different in the two cases. It is concluded then an appreciable inelastic contribution is present in the case of conventional diffraction. Author

N68-14547* Utah Univ., Salt Lake City.
AN EPR INVESTIGATION OF NEWLY-FORMED FRACTURE SURFACES
M. L. Williams and K. L. DeVries Aug. 1967 26 p refs Presented at the 14th Sagamore Army Mater. Res. Conf., Raquette Lake, N. Y., 22–25 Aug. 1967
(Grants NGR-45-003-037; NSF GK-1376)
(NASA-CR-91816; UTEC-DO-67-006) CFSTI: $3.00 CSCL 11I

Experimental results are presented of electron paramagnetic resonance studies concerning the formation of free radicals during mechanical fracture and γ-irradiation of polymeric materials. The free radicals are identified, and the rates of recombination and reaction with oxygen are discussed. Included are preliminary tensile fracture data for drawn Nylon 6 fibers. K.W.

N68-14601# Sandia Corp., Livermore, Calif.
ATTENUATION OF LONGITUDINAL, ULTRASONIC SOUND WAVES IN VARIOUS PLASTICS
C. E. Johnston Oct. 1967 12 p
(Contract AT(29-1)-789)
(SCL-DR-67-110) CFSTI: HC $3.00/MF $0.65

The results of a study of the properties of a group of materials, especially as these properties pertained to the use of each material as an ultrasonic lens is reported. Primary emphasis was on determining signal loss by attenuation. Author (NSA)

N68-14619# Air Force Systems Command, Wright-Patterson AFB, Ohio. Fibrous Materials Branch.
EVALUATION TECHNIQUES FOR FIBERS AND YARNS USED BY THE FIBROUS MATERIALS BRANCH, NONMETALLIC MATERIALS DIVISION, AIR FORCE MATERIALS LABORATORY
Sep. 1967 107 p refs
(AFML-TR-67-159; AD-662355)

The report describes the techniques which are used for evaluating some of the important mechanical and physical properties of fibers and yarns. These include density, strength, modulus of elasticity, and repeated flexing properties. The test procedures described are those in use at the time this report was prepared. They have been in use for some time and a considerable amount of data have been generated which has demonstrated the reliability of the methods. These techniques and procedures will be reviewed and updated as required. They are compiled and reported for the purpose of: (1) acquainting those concerned with fiber property measurement with those techniques which have been found to be useful for gathering data on a variety of types of fibers; and, (2) to provide air force contractors and fiber users with the basic techniques used by the Air Force materials laboratory in order that valid comparisons of data can be made. Author (TAB)

N68-14771 Centre d'Etudes de l'Energie Nucleaire, Mol (Belgium).
PHYSICAL PROPERTIES OF UO_2 SINGLE CRYSTALS
R. Gevers, et al Brussels EURATOM Oct. 1967 104 p refs
(Contract EURATOM-056-64-3-TEEB)
(EUR-3323.E; EURAEC-1776)

Further progress in the investigation of different fundamental physical properties of uranium dioxide is presented. The following studies were undertaken: the preparation of big single crystals using large sintered cylinders made by slip casting; the observation in the optical microscope of the structure of U_4O_9 precipitates in UO_{2+x} with various oxygen contents; the observation of anti-phase boundaries in thin foils of U_4O_9; the measurement of the thermal conductivity of stoichiometric and slightly oxidized UO_2 in the temperature range between 4.2 and 300°K; the study of the electrical conductivity; the study of some motion phenomena of uranium and oxygen ions in UO_2; this includes the determination of the diffusion coefficients for the uranium-235 ion in stoichiometric UO_2; the activation energies for migration of uranium point defects and oxygen interstitials and the activation energy for reorientation of oxygen interstitials; the measurement of the magnetic susceptibility of UO_{2+x} crystals with $0 < X < 0.25$ at temperatures ranging from 90 to 300°K and magnetic fields between 7 and 11 kOe. Author

N68-14797* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ISOTROPIC PLASTICITY OF GRAPHITE
D. B. Fischbach 1 Jan. 1968 9 p refs
(Contract NAS7-100)
(NASA-CR-91832; TR-32-1237) CFSTI: $3.00

A study of the dimensional changes accompanying the high temperature plastic deformation of pyrolytic carbon suggests that this material deforms like a homogeneous, isotropic solid. At the end of the first stage of deformation a width increase of about 3% and a thickness decrease of about 12% had occurred. However, upon continued tensile elongation both the width and the thickness were observed to decrease at the same rate as a function of elongation. Author

N68-14875# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
TECHNIQUES IN NUCLEAR CERAMIC RESEARCH
J. F. White and E. S. Fitzsimmons Oct. 1967 19 p refs
(Contract AT(40-1)-2847)
(GEMP-557) CFSTI: HC $3.00/MF $0.65

The techniques peculiar to nuclear ceramic research are discussed with respect to the handling of radioactive and toxic materials. The effects of neutron radiation on BeO are highlighted to illustrate methods of determining property changes that can occur in a nuclear reactor environment; i.e., analyses of grain boundary separation, electron micrographs of the dislocation loops and He bubbles, the change in volume caused by irradiation, and the change in thermal diffusivity at different temperatures of irradiation. The high temperature properties of UO_2 as a function of stoichiometry are discussed in terms of the melting point, vapor pressure, and uranium-urania phase equilibrium to illustrate some of the current in-depths studies of ceramic materials of interest in nuclear energy. Author (NSA)

N68-14884# Sandia Corp., Albuquerque, N. Mex.
PULSED VOLTAGE BREAKDOWN TESTS OF FREONS
N. R. Carpenter Sep. 1967 19 p refs
(SC-M-67-641; TID-4500) CFSTI: HC $3.00/MF $0.65

Tests were made to determine the voltage holdoff of Freon cleaning agents and electronic grade Freons when exposed to voltage impulses of 10-μsec duration. The results, when compared to similar tests of transformer oil, show Freon cleaning agents to have less dielectric strength than transformer oil while the electronic grade Freons compare very favorably with the oil. The tests were made with four different electrodes to show the effect of the test geometry on the breakdown value. Also included are tests of Freons to which impurities have been added and tests made with assemblies in place of electrodes. Author

N68-14914# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
PHASE SEPARATION IN THE SYSTEM $BaO-SiO_2$
T. P. Seward, III, D. R. Uhlmann, and D. Turnbull Sep. 1967 35 p refs
(Contract Nonr-1866(50))
(TR-12; AD-662402)

A simple rapid quenching device was used to investigate the extent of liquid-liquid immiscibility in the system BaO-SiO2. A metastable miscibility gap was found with an upper consolute point at about 10 mole percent BaO and 1480C. Bulk glass samples of different compositions and heat treatments were examined by direct transmission electron microscopy to determine the phase separation morphology. At low BaO contents the separation was

characterized by spherical barium-rich particles in a silica-rich matrix. For compositions near the center of the gap, the structure consisted of two phases, continuously interconnected throughout the bulk of the glass. At higher BaO contents spherical silica-rich particles were found in a barium-rich matrix. The dependence of the morphology on quench rate and heat treatment was investigated. Predictions of other authors concerning the occurrence of BaO-SiO2 immiscibility are compared with the present results. Author (TAB)

N68-14991# Westland Aircraft, Ltd., Yeovil (England).
INVESTIGATION INTO THE USE OF REINFORCED PLASTICS IN THE WESSEX HELICOPTER TO PREVENT CORROSION
N. L. Bottrell Jul. 1967 27 p
(Contract KK/M/74/CB.25(a))
(D-MAT-148; AD-662371)

Magnesium is used extensively in the Westland Wessex helicopter for transmission castings and in the skin-stringer constructed fuselage. Replacement of magnesium by a glass fabric reinforced resin composite was found to solve corrosion problems in the case of the tail gearbox fairing. Three tail gearbox fairings were built; two were required to compare stiffness and impact resistance with the metal counterparts and the third was required to establish that adequate resistance to simulated aerodynamic loads was obtained. The tests were performed satisfactorily and the properties measured gave good agreement with those of the metal components. The use of reinforced plastic for the cabin door proved unsatisfactory. A design study of the proposed replacement of the engine nose door by a reinforced plastic component showed that this could be done with advantage, both with sandwich and with skin-stringer types of construction; certain essential metallic components would be retained, but aluminum and titanium alloys would be used in place of magnesium in order to minimise corrosion effects. Author (TAB)

N68-14999 Lockheed Missiles and Space Co., Sunnyvale, Calif.
PROLONGED RESISTANCE OF FIBERGLASS REINFORCED PLASTICS UNDER BIAXIAL COMPRESSION BY A CONSTANT LOADING
F. P. Beliankin, V. F. Iatsenko, and G. G. Margolin 6 Apr. 1967 3 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), No. 10, 1967 p 925–927

For structural fiberglass reinforced plastics of weak anisotropy and under biaxial compression by constant loading the support strength/yield point ratio has closed values in both directions of the principal axes of anisotropy. The conditionally instantaneous stress is a function of the yield point in both the mutually-perpendicular directions. Prolonged resistance limits of each component are determined by means of statistically processed experimental values for both rupture stress components as a function of rupture time. G.G.

N68-15001*# Washington Univ., Seattle. Ceramic Engineering Div.
MULTIDISCIPLINARY RESEARCH ACTIVITY IN THE MATERIALS SCIENCES WITH EMPHASIS ON CERAMIC MATERIALS Semiannual Status Report, Jun. 16–Dec. 15, 1967
James I. Mueller 15 Dec. 1967 40 p
(Grant NsG-484)
(NASA-CR-91660; SASR-9) CFSTI: HC $3.00/MF $0.65 CSCL 11B

The following topics are discussed: (1) *Studies of the Zirconium–Oxygen–Carbon System*—thermomechanics of the gas-solid equilibrium in the zirconium oxy-carbide and dioxide-carbon reactions, electronic energies in the zirconium–carbon–oxygen compositions, thermodynamics and kinetics of chemical reactions in oxide–carbide–graphite, and phase boundaries in ternary phase diagrams; (2) *Solid State Ceramics*—development of microscopic model for the polarization reversal process in hydrogen bonded ferroelectrics, ceramical microstructures, atomic bonding and lattice dynamics in ceramics, solar radiation effects, energy storage mechanisms in ferroelectric materials, and defective structures of single crystals; (3) *Surface Phenomena*—grain boundaries in aluminum oxide bicrystals, methods of electromagnetic horn pattern shaping, and measurements of surface diffusion coefficients; and (4) *Processing*—effects of processing variables upon the micro- and macro-structures of ceramic materials. G.G.

N68-15002*# National Bureau of Standards, Washington, D. C.
THERMAL AND OXIDATIVE DEGRADATION OF AROMATIC AND HETEROCYCLIC POLYMERS Progress Report, May 1, 1966–Aug. 1, 1967
Leo A. Wall Jan. 1968 6 p refs
(NASA Order R-56)
(NASA-CR-91659; Rept.-31102-11-3110540) CFSTI: HC $3.00/MF $0.65 CSCL 11I

A new thermogravimetric apparatus for both isothermal and non-isothermal thermogravimetry up to 1000°C was constructed and used to determine those mechanisms of solid state reactions in polycarbonate "Lexan" that produced the intractable and carbon-like residue. A series of pyrolyses up to 600°C in air, in a vacuum of H-film were carried out; preliminary results showed that the more aromatic the content in the material the more char-like, insoluble, or intractable the products became. G.G.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-13988*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGNS OF EXPERIMENTS AS TELESCOPING SEQUENCES OF BLOCKS
Arthur G. Holms [1967] 36 p refs Presented at the 13th Conf. on the Design of Expt. in Army Res., Develop., and Testing, Ft. Belvoir, Va., 1–3 Nov., 1967 Sponsored by the Army
(NASA-TM-X-52374) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Sequences of orthogonally blocked statitical designs of experiments were presented for optimum seeking. The sequences were such that observations from the first block can be used to estimate the coefficients of a simple model and then be retained and combined with observations from new blocks so that all acquired observations were used cumulatively to estimate models of successively greater generality. Such blocks are said to form a telescoping sequence. Specific choices were motivated by the problem of optimum seeking experiments in alloy development. The designs consist of full and fractionally replicated two-level factorial experiments with four to eight factors. The sizes of the experiments include 8, 16, 32, and 64 treatments. Author

N68-14038 University Microfilms, Inc., Ann Arbor, Mich.
ALGORITHMIC SOLUTIONS OF THE CONJUGACY PROBLEM IN SOME GENERALIZED FREE PRODUCTS
Brigid Driscoll (Ph.D. Thesis—N. Y. Univ.) 1967 58 p refs
(Rept.-67-12558)

The general theorem on conjugacy in a generalized free product is presented together with sufficient conditions for providing an algorithmic solution to the conjugacy problem. Special conditions on the factors or on the amalgamated subgroup giving rise to a solution are discussed. A detailed study is made of an algorithmic solution when the amalgamated subgroup is cyclic and the factors are either free, torsion-free nilpotent, or free metabelian groups. An investigation is made of torsion-free nilpotent factors in which the subgroup can be enlarged from cyclic to abelian of rank two. Some problems encountered in attempting to secure more general results are discussed in detail. C.T.C.

N68-14065# Union Carbide Nuclear Co., Oak Ridge, Tenn. Computing Technology Center.
DECISION TABLES FOR DOCUMENTATION AND SYSTEM ANALYSIS
H. R. Gregg 3 Oct. 1967 4 p refs
(Contract W-7405-ENG-26)
(K-1718) CFSTI: HC$3.00/MF$0.65

People have difficulty both in developing and using logic, mainly due to inability of the human mind to simultaneously consider more than a few alternatives and their relationships. The logic of a problem can always be written out in sentences, but this necessitates a sequential consideration of alternative paths rather than the more desirable simultaneous consideration. The written definition may be exact, but is prone to misinterpretation and erroneous conclusions. For this reason, techniques such as flow charts, symbolic logic, and algebra are used, but again, they are primarily sequential methods of expressing logic. Decision tables are two-dimensional in nature and therefore enable us to fully express and consider both the sequential and parallel aspects of logic. This makes them uniquely suited to logic expression and development. Author (NSA)

N68-14077*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVELOPMENT OF A GENERAL FORMULA EXPANDING THE HIGHER-ORDER DERIVATIVES OF THE FUNCTION TANH Z IN POWERS OF TANH Z AND A-NUMBERS
Hans H. Hosenthien Washington Jan. 1968 13 p refs
(NASA-TN-D-4396) CFSTI: $3.00/MF$0.65 CSCL 12A

A general formula for the rth derivative of the function tanh z with respect to z is developed. This formula is a finite polynominal in powers of tanh z where the coefficients are of simple structure containing A-numbers. The A-numbers, $A_r^{(m)}$, of order m and degree r are introduced as an abbreviation for an expression containing C-numbers which are related to Euler's numbers. A recursion formula the A-numbers and their special properties are derived. The paper contains a tabulation of derivatives of tanh z from the first to the sixth order as well as a table of A-numbers covering all combinations of order and degree from 0 to 10. Author

N68-14130# Tennessee Univ., Knoxville.
OSCILLATORY BEHAVIOR OF SOLUTIONS OF LINEAR ORDINARY DIFFERENTIAL EQUATIONS OF THIRD ORDER
J. Michael Dolan (Ph.D. Thesis) Aug. 1967 147 p refs Sponsored by AEC
(TID-24051) CFSTI: HC$3.00/MF$0.65

The oscillatory behavior of solutions of the canonical third-order linear differential equation $L_3(y) = \{\gamma_2[(\gamma_1 y')' + q_1 y]\}' + q_2(\gamma_1 y') = 0$ on an interval I where γ_i, q_i belongs to C(I) and $\gamma_i > 0$ on I, i = 1, 2 is investigated. Qualitative theories of first extremal points, conjugate points, and focal points of the equation are developed. NSA

N68-14264*# Serendipity Associates, Chatsworth, Calif.
A SIMPLE CALCULUS FOR DISCRETE SYSTEMS. PART B
J. Jepson Wulff, Alden F. Pixley (Harvey Mudd Coll.), and Jon N. Leonard *in its* A Descriptive Model for Determining Optimal Human Performance in Systems, Vol. 1 Jan. 1968 31 p refs (See N68-14262 05-05)

A mathematical model is presented for talking about system development cycles. The language development was based on the assumptions that it would be in accordance with the conventions of mathematics, that it would articulate with PERT and probability calculus, and that it would be possible to utilize computers for testing and manipulating detailed development cycle models. Details are presented on the language and its use. N.E.N.

N68-14268# Chrysler Corp., Huntsville, Ala. Space Div.
LINEAR ERROR ANALYSIS AND FILTERING BY RECURSIVE LEAST SQUARES
C. E. Nickel 16 Jun. 1967 27 p refs
(HSM-M58-67)

The basic concepts of linear error analysis are presented for use in the statistical analysis of physical systems described by first order differential equations where the variates are stochastic. Changes in the static of such physical systems caused by Gaussian random processes are examined and applied to a typical space navigation problem. In addition, the recursive method of least squares is developed and applied as a linear filter in obtaining an estimate of state in a typical orbit determination problem. Author

N68-14318# Brookhaven National Lab., Upton, N. Y.
A NONLINEAR DIRICHLET PROBLEM WITH APPLICATION TO QUASI-LINEAR PROBLEMS
Dale W. Lick [1967] 7 p refs Sponsored by AEC
(BNL-11811; AMD-477) CFSTI: HC$3.00/MF$0.65

The Dirichlet problem $\Delta u = f(u)$, $u \geq 0$, in R; and $u = \phi\xi$, on ∂R, where Δ is the Laplacian, f is nonlinear, and ϕ is positive and continuous, is considered. Using results of Bers and a simple continuation technique, it is shown that the finite difference analog of this problem has a unique solution and this solution converges to the analytic solution. These results are applied to quasilinear problems with nonnegative solutions. Author (NSA)

N68-14323# Los Alamos Scientific Lab., N. Mex.
ENUMERATION OF LINEAR GRAPHS AND CONNECTED LINEAR GRAPHS UP TO P = 18 POINTS
Myron L. Stein and Paul R. Stein 5 Oct. 1967 72 p refs
(Contract W-7405-ENG-36)
(LA-3775) CFSTI: HC$3.00/MF$0.65

The number of linear graphs $L_{p,k}$ and connected graphs $C_{p,k}$ with p points and k lines up to and including p = 18, calculated with the MANIAC II electronic computer, is presented. Some practical aspects of the calculation and asymptotic properties of the $L_{p,k}$ are briefly discussed. NSA

N68-14402* Drexel Inst. of Tech., Philadelphia, Pa.
RESEARCH IN METHODS OF GENERATING LIAPUNOV FUNCTIONS Final Report
E. Norman, W. Trench, and R. Drake 11 Aug. 1967 54 p refs
(Contract NAS8-20347)
(NASA-CR-61437) CFSTI: $3.00 CSCL 12A

The results of a number of attempts to find underlying principles uniting the many methods for generating Liapunov functions for

nonlinear systems of ordinary differential equations are given. Our conclusions indicate that if general principles exist for the generation of Liapunov functions they lie very deep, and are not to be found among the methods now in use. Author

N68-14442# Park Mathematical Labs., Inc., Carlisle, Mass.
ON THE THEORY OF BOOLEAN FORMULAS: SUBSTITUTION, REPLACEMENTS AND PRIME FORMULAS
E. W. Samson and L. Calabi Sep. 1967 25 p refs
(Contract AF 19(628)-4790)
(SR-4; AFCRL-67-0541; AD-662324)

Discursive presentation of central notions and results developed in a study of Boolean formulas. The definition of formula used here is more general than that of function, less general than that of word. Discussed are: subformulas, substitution of subformulas, replacements with constraints and a very broad concept of prime implicant. Author (TAB)

N68-14501*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A NUMERICAL TABLE OF LOMMEL FUNCTIONS WITH TWO IMAGINARY ARGUMENTS
E. Wai-Kwok Ng 15 Jan. 1968 17 p refs
(Contract NAS7-100)
(NASA-CR-91729; JPL-TR-32-1193) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A numerical table is given for Lommel functions of two imaginary arguments. The values are obtained from a truncated Neumann Series, which was found empirically to be decidedly superior to simple numerical quadrature. Author

N68-14860# Sandia Corp., Albuquerque, N. Mex.
MATCHING ALGORITHMS
Donald R. Morrison Sep. 1967 17 p refs
(Contract AT(29-1)-789)
(SC-RR-67-742) CFSTI: HC $3.00/MF $0.65

A graph M is a matching if every point is incident on exactly one line, every line on exactly two points. The following problems arise in scheduling interviews and other kinds of matchings. Given a bipartite graph B: find a matching M in B, with a maximum number of lines; find a matching M in B, which includes all the points in B whose number of incident lines is maximal; find a sequence $M_1, M_2, \ldots M_R$ of matchings in B, whose union is B and whose number is minimal. Algorithms are described to solve these and other problems efficiently. The key tools are a class of graphs called ionizations, more general than matchings and more special than bipartite graphs, and a class of transformations called improvements of the ionizations in a bipartite graph B. The matchings in an ionization and the improvements applicable to it are particularly easy to describe and to catalog. The algorithms consist of applying improvements to an ionization until no more are applicable and then extracting from the ionization the required matching. Author (NSA)

N68-14882# Sandia Corp., Albuquerque, N. Mex.
ORTHOGONAL ARRAYS OF ODD INDEX
J. R. Blum (New Mexico Univ.) and J. A. Schatz Sep. 1967 10 p refs
(Contract AT(29-1)-789; Grant NSF GP-5217)
(SC-RR-67-650) CFSTI: HC $3.00/MF $0.65

A theorem establishing the existence of orthogonal matrices of odd index is proven. $M(\lambda,t)$ is defined as the maximum value of m, for given positive integers λ and t, for an $m \times \lambda 2^t$ matrix of zeros and ones with $m>t$. The inequality $m>t$ has the property that, for every choice of t rows each of the 2^t possible distinct column vectors occurs precisely λ times. Proof of the theorem is based on properties of inequalities and array properties of matrices. NSA

N68-14887# RAND Corp., Santa Monica, Calif.
CAUCHY AND FREDHOLM METHODS FOR EULER EQUATIONS
H. Kagiwada, R. Kalaba, A. Schumitzky, and R. Sridhar Nov. 1967 16 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5502-PR; AD-662316)

The report demonstrates alternative methods of minimizing a quadratic functional, which is frequently an essential step in the solution of problems in mathematical physics, mechanics, and engineering. Three methods are discussed: (1) the classical approach through Euler equations, subject to boundary conditions; (2) an approach through the solution of a Fredholm integral equation; (3) the initial-value approach, based on the dynamic programming and invariant imbedding. Each method has certain analytic and computational advantages and disadvantages. To illustrate the methods, the study considers the equilibrium configuration of a tightly stretched string, restrained by distributed strings, acted upon by a distributed load, and constrained at the ends in various ways. TAB

N68-14910# Brown Univ., Providence, R. I. Dept. of Physics.
THE STEEPEST ASCENT/DESCENT METHOD
Joseph Rosen May 1967 12 p refs
(Contract AT(30-1)-2262)
(NYO-2262TA-157) CFSTI: HC $3.00/MF $0.65

The steepest ascent/descent method, a procedure for increasing or decreasing a function of more than one variable, possibly for the purpose of finding maxima or minima, is described in theory and in practice. Curve fitting is presented as an application. Various complications are discussed. Author (NSA)

N68-14967# Wisconsin Univ., Madison. Mathematics Research Center.
A CLASS OF NONLINEAR EIGENVALUE PROBLEMS
R. E. L. Turner Aug. 1967 44 p refs
(Contract DA-31-124-ARO-D-462)
(MRC-TSR-792; AD-662738)

The report considers the nonlinear eigenvalue problem $(A - B(\lambda))x = 0$ in a Hilbert space, where $A = or > 0$ is compact and $B(\lambda)$ is a polynomial with nonnegative operator coefficients, satisfying $B(0) = 0$. It is shewn that if A and $B(\lambda)$ are in certain operator classes, then there exists an unconditional basis of the Hilbert space consisting of eigenvectors x corresponding to nonnegative eigenvalues λ. It is also shown that the nonnegative eigenvalues can be characterized by variational principles. Author (TAB)

N68-14993# Wisconsin Univ., Madison. Mathematics Research Center.
APPROXIMATE SOLUTION OF INITIAL BOUNDARY WAVE EQUATION PROBLEMS BY BOUNDARY VALUE TECHNIQUES
Donald Greenspan Aug. 1967 24 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-778; AD-662735)

The paper contains numerical studies of initial-boundary value problems for linear and mildly nonlinear wave equations. Boundary value techniques are applied to problems for which asymptotic estimates or periodicity theorems are available. Stability problems are thereby averted completely. Author (TAB)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-13950# Commonwealth Scientific and Industrial Research Organization, Melbourne, (Australia).
METEOROLOGICAL PHYSICS DIVISION ANNUAL REPORT, 1966–1967
1967 38 p refs

Summary data are presented on the meteorological research which is being conducted, and the application of this information to problems of economic importance in Australia. Interest in dynamic and synoptic meteorology is centered on general atmospheric circulation and radar meteorology. Upper atmosphere studies pertain to the synoptic distribution of ozone, surface ozone measurements, and an assessment of radioactivity and volcanic dust as upper atmosphere tracers. Micrometeorological observations are discussed, and efforts to determine the response of transmission lines and towers to gale-force gusts are reported. Consideration is also being given to various types of evaporation formulas which use such available meteorological parameters as radiation and water vapor pressure; transpiration reduction; evaporation recording instruments; and radiation measurement equipment. Computation and data processing activities are mentioned. M.G.J.

N68-14212*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
PROJECT FOG DROPS: INVESTIGATION OF WARM FOG PROPERTIES AND FOG MODIFICATION CONCEPTS
Quarterly Progress Report
Warren C. Kocmond 15 Jan. 1968 12 p ref
(Contract NASr-156)
(NASA-CR-91683; CAL-RM-1788-P-18) CFSTI: HC $3.00/MF $0.65 CSCL 04B

Progress is reported in the following major task areas which included: (1) theoretical modeling of fog modification; (2) a climatic survey of fog frequency in the Buffalo, New York area; (3) large scale laboratory experiments to test different size distributions of NaCl nuclei and also to test the effectiveness of seeding fogs with urea; and (4) planning and preparations for field testing of the proposed seeding concept. A computer program was developed to simulate the response of natural and artificial fogs to seeding with hygroscopic nuclei. It is anticipated that the ability of this computer model to simulate the effects of various seeding materials, nucleus size distributions, and seeding methods on different fog types will produce valuable inputs to the planned field experimentation program. As part of a study to determine the frequency of fog occurrence, fog density, and duration in the Buffalo, New York area, the average number of fogs per month that could be considered suitable for seeding were determined. Of all fogs surveyed, only a small percentage were classified as seedable. Fog seeding experiments designed to test the effectiveness of seeding fogs with different size distributions of NaCl nuclei, and also to examine the behavior of fogs seeded with urea crystals of prescribed sizes, are summarized. Plans for initial field tests of the proposed seeding concept, and instrumentation which will be used for these tests, are also discussed. S.C.W.

N68-14217# Brookhaven National Lab., Upton, N. Y.
MICROMETEOROLOGY OF THE TURBULENT FLOW FIELD IN THE ATMOSPHERIC SURFACE BOUNDARY LAYER
I. A. Singer, Niels Busch, and J. A. Frizzola 31 Aug. 1967 50 p refs Presented at the Intern. Res. Seminar on Wind Effects on Buildings and Struct., Ottawa
(BNL-11800; CONF-670943-1) CFSTI: HC $3.00/MF $0.65

The background for the Monin–Obukhov similarity hypothesis which describes the height dependence of various turbulent flow parameters in a thermally stratified surface boundary layer is outlined. The hypothesis can be regarded as a dimensional analysis assuming that gradients in the parameters are unique functions of the height of observation, the friction velocity, the vertical temperature flux, and the buoyancy parameter. The implications of the hypothesis are discussed. A recent analysis of spectral data under thermally neutral and unstable conditions is presented and compared with other analyses. Author (NSA)

N68-14272 Joint Publications Research Service, Washington, D. C.
BIOGRAPHY OF A TYPHOON
K'o-ch'in Tung *In its* Transl. on Communist China: Sci. and Technol., No. 397 4 Jan. 1968 p 1–7 Transl. into ENGLISH from K'o Hsueh Ta Chung (Peking), no. 8, Aug. 1964 p 298–299 (See N68-14271 05-34)

A brief account is presented of the development, velocity and path, and characteristics of typhoons. The damage inflicted by the storms is discussed, and folk sayings predicting the typhoons are given. N.E.N.

N68-14273 Joint Publications Research Service, Washington, D. C.
CLOUD SEEDING FOR SNOW
Chia-tung Yeh *In its* Transl. on Communist China: Sci. and Technol., No. 397 4 Jan. 1968 p 10–14 Transl. into ENGLISH from K'O Hsueh Hua Pao (Shanghai), no. 3, Mar. 1964 p 102–103 (See N68-14271 05-34)

The rain and snow producing mechanisms in clouds are described briefly, including the conditions under which the precipitation will be formed. The use of silver iodide as a catalyst in cloud seeding is mentioned, and the need for studying the phenomena resulting from artificial catalysis is indicated. Preliminary experiments in cloud seeding, producing snow fall from 2 to 12 minutes, are mentioned. N.E.N.

N68-14806# Environmental Science Services Administration, Washington, D. C.
REPORT OF THE NATIONAL COMMITTEE FOR CLEAR AIR TURBULENCE
Dec. 1966 51 p refs
GPO: $0.35

An introduction to the clear air turbulence problem is presented, and the requirements and general recommendations for its solution are evaluated. Specific recommendations relating to measurements and observations are made, and requirements of remote detection, pilot/aircraft response, forecasting, and dissemination are presented. Areas covered include evaluation of the needs, existing programs and deficiencies, priorities for future action, forecasting, research and development projects, and requirement justifications. C.T.C.

N68-14902# Defence Research Board, Ottawa (Ontario).
HYDROMETEOROLOGICAL CONDITIONS CAUSING ICE ACCRETION ON SHIPS
G. V. Vasil'yeva Nov. 1967 5 p Transl. into ENGLISH from Rybn. Khozy. (Moscow), no. 12, 1966 p 43–45
(T-486-R)

Information on hydrometeorological conditions that favor the development of shipboard ice accretion is presented, and the synoptic weather processes that promote this phenomenon are briefly described. Included are discussions of geographical areas where these phenomena are most prevalent. C.T.C.

N68-14930# National Weather Records Center, Asheville, N. C.
WORLD-WIDE AIRFIELD SUMMARIES. VOLUME 3. FAR EAST
Oct. 1967 474 p
(AD-662426)

The volume is part of a series of compilations which is world-wide in scope. It consists of climatological summaries for selected airfields and for the climatic areas in which they are located. When complete, the series will include data for approximately 3000 stations. The summaries are given by country, in alphabetical order. TAB

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-13945 Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
FIELD APPRAISAL OF THE ADVANCED RADAR TRAFFIC CONTROL SYSTEM (ARTS) Final Report
Philip Karsten Oct. 1967 112 p refs Appendix
(RD-67-3)

The findings of the ARTS Field Appraisal (April 1965–February 1966) and the Final Approach Spacing for ARTS (FASA) Field Appraisal (March–August 1966) are described in detail. The ARTS tracking and display features were basically acceptable for operational use; however, tracking process modifications and improved displays are needed. Operational advantages could be achieved by the authorized use of the Mode C altitude displays and the intra-facility handoff capability. The FASA field appraisal efforts were incomplete and inconclusive with respect to the original objectives. The amount of data collected during the field appraisal was too voluminous to be included in this document; therefore, only the more pertinent statistics have been used. Author

N68-13946 Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
FIELD APPRAISAL OF THE ADVANCED RADAR TRAFFIC CONTROL SYSTEM (ARTS) Final Report, Apr. 1965–Feb. 1966
Philip Karsten Oct. 1967 44 p
(RD-67-2)

ARTS objectives were to determine (1) the operational advantages of electronic tracking of primary radar and beacon targets with associated alphanumeric flight data in a terminal environment with a single radar and collocated beacon, and (2) the specific capabilities and characteristics that should be embodied in follow-on systems. The FASA objective was to determine the effectiveness of the FASA time-to-turn concept in providing computer assistance in the sequencing and spacing of arrival aircraft. The ARTS tracking and display features were basically acceptable for operational use; however, tracking process modifications and improved displays are needed. Operational advantages could be achieved by the authorized use of Mode C altitude displays and the intra-facility handoff capability. The FASA field appraisal efforts were incomplete and inconclusive with respect to its orginal objectives. This report presents an overall view. Author

N68-14021 Federal Aviation Agency, Washington, D. C. Dept. of Transportation.
EN ROUTE IFR AIR TRAFFIC RELATIONSHIPS, FY1966 Staff Study
Wallace L. Ashby, Ellen S. Reynolds, and Richard M. Warfield Nov. 1967 292 p
(RD-67-71)

Annual, peak day, peak hour and peak minute en route IFR air traffic relationships in FY1966 are examined by Air Route Traffic Control Center and by aviation category (air carrier, general aviation, military). Distributions of Friday activity throughout CY1966 are developed, as are distributions of minute-by-minute activity during a peak hour. En route IFR flight activity in 1966 is compared with that in 1959. Listings of all flights active within each Center's area during its peak three-hour period in FY1966 are included for use in current studies and to provide historical bench marks for future system effectiveness studies. Author

N68-14024# Elliott Bros., Ltd., London (England). Space and Guided Weapons Div.
INVESTIGATION OF THE SUITABILITY OF THE ELLIOTT MCS 920M DIGITAL COMPUTER FOR THE NAVIGATION AND GUIDANCE OF THE ELDO SATELLITE LAUNCH VEHICLE
[1967] 58 p Prepared for ELDO
(Contract KM/3C/2034/CB.21(d))
CFSTI: HC $3.00/MF $0.65

The purpose of the study was to discover whether or not an airborne digital computer having a word length of 18 bits only, would introduce a significant deterioration in the accuracy with which vehicles like ELDO A or B may be guided by inertial means. The study established that the Elliott MCS 920M digital computer having a fixed point, 18 bit wordlength can be programmed to provide navigation data and guidance demands for accurate inertial guidance of the ELDO launch vehicle into a near-earth orbit. Author (ESRO)

N68-14163*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Avionics Lab.
EXPERIMENT D005 (D-5), STAR OCCULTATION NAVIGATION
Robert M. Silva, Terry R. Jorris, and Eugene M. Vallerie, III (NASA. Manned Spacecraft Center) *IN* NASA. Manned Spacecraft Center Manned Spaceflight Expt. Gemini 10 Mission Mar. 1967 p 115–124 (See N68-14150 05-30)

An electronic star occultation photometer was used by astronauts for space navigation and to measure horizon density profiles during Gemini 10 flight. The instrument measured the relative intensity of a star by photomultiplier and measurement data

plotted against time provided the attenuation curve of the star passing through the earth's atmosphere relative to an attenuated intensity. Representative telemetry plots of normalized star light intensity observations from Gemini 10, with time in seconds horizontally and normalized star intensity in volts vertically, are shown in tables. G.G.

N68-14164*# Air Force Cambridge Research Labs., Bedford, Mass.
EXPERIMENT D010 (D-10), ION-SENSING ATTITUDE CONTROL
Rita C. Sagalyn *In* NASA. Manned Spacecraft Center Manned Spaceflight Expt. Gemini 10 Mission Mar. 1967 p 125–134 (See N68-14150 05-30)

The ion-sensing attitude control experiment was to investigate the feasibility of an attitude control system that uses environmental positive ions and an electrostatic detection system to measure spacecraft pitch and yaw as well as the spatial and temporal variations of ambient positively charged particles along the Gemini spacecraft's orbit. Responses of the pitch and yaw attitude sensors, mounted on outside booms, were observed during roll attitude, pitch attitude, yaw attitude, and random data accumulation during drifting flight. Postflight analysis of the transmitted data and the astronauts' inflight comparison of the ion-sensing system with the inertial guidance system showed that the two systems agreed in absolute magnitude measurements of both pitch and yaw angles; the system responded very rapidly to variations in angular position. G.G.

N68-14647*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMPARISON OF THE ATLAS/CENTAUR (SURVEYOR) AND IGM GUIDANCE CONCEPTS
W. G. Green and W. B. Tucker 22 Nov. 1964 13 p refs
(NASA-TM-X-53674) CFSTI: HC$3.00/MF$0.65 CSCL 17G

The current Iterative Guidance Mode (IGM) guidance concept and the Atlas/Centaur (Surveyor) guidance concept are both capable of performing the guidance functions associated with (1) injection into near-circular earth orbits ranging outward to synchronous altitude, or highly eccentric earth orbits; (2) injection into lunar or interplanetary transfer orbits; (3) deboost into orbit about a planetary body, and (4) deboost into a landing ellipse (assuming no atmosphere) from which soft-landing procedures may be initiated. Neither concept in its current form is considered capable of performing midcourse corrections nor orbit modification maneuvers in general, unless a data link is used to supply steering parameters directly for these maneuvers. Author

N68-14732*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A STUDY OF THE EFFECT OF MEASUREMENT ERRORS UPON A RANGE CONTROLLER FOR AN ENTRY VEHICLE
Jack A. White Washington Jan. 1968 32 p refs
(NASA-TN-D-4317) CFSTI: HC$3.00/MF$0.65 CSCL 17G

A study of a range controller for an entry vehicle has been made. Three basic path trajectories to simulate short-range entries, medium-range entries, and long-range entries requiring a skip maneuver were selected for the study. The range controller used a bang–bang control during the initial dive into the atmosphere and during the pull-up phase for medium- or long-range entry. Control during the other phases of the trajectory was achieved by a linear-type controller that is dependent upon the solution of desired altitude as a function of desired range. A random number procedure was used to determine the effect of random errors in measuring the vehicle velocity, altitude, and rate of change of altitude upon the effectiveness of the range controller to control the vehicle to the desired range. Results of this study show that the range controller was able to control the vehicle from the entry point for angular ranges varying from 18° to 250°. The controller had about the same sensitivity to measurement errors for medium-range and long-range entries. Author

N68-14823 Human Factors Research, Inc., Santa Barbara, Calif.
AERONAUTICAL CHARTS AND MAP DISPLAYS
James J. McGrath, ed. Aug. 1967 131 p refs Symp. held in Washington, D. C., 8–10 Nov. 1966
(Contract N00014-66-C-0040)
(AD-661490)

Conference papers are presented on the technologies related to the development and use of map–display systems for manned military aircraft, with emphasis focused on the problems encountered in incorporating aeronautical charts and other earth-reference materials into map displays. For individual titles, see N68-14824 through N68-14852.

N68-14824 Defense Intelligence Agency, Washington, D. C.
CARTOGRAPHIC COMMUNITY SUPPORT OF AIR OPERATIONS
Robert E. Herndon, Jr. *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 11–21 (See N68-14823 05-21)

The structure and interrelationships of the United States cartographic–geodetic community is discussed in terms of the responsibilities of each branch of the Armed Services, and the cooperation between other agencies and foreign countries. The concept of the DOD management system is described, with the five major phases identified as product requirement validation, area requirements and priorities validation, integrated programming and budgeting, evaluation of performance against program and cost objectives, and technical processes improvement. An organizational chart is included to show how mapping, charting, and geodesy management fits into the Defense Intelligence Agency. The technical activities involved in meeting the requirements of air operations are listed. Consideration is also given to the types of people who evaluate proposed programs, and to the criteria used for establishing priorities. M.G.J.

N68-14825 ITT Gilfillan, Inc., Los Angeles, Calif.
THE NAVIGATION CHART AS A DESIGN ELEMENT OF AN INTEGRATED AVIONICS SYSTEM
Eric S. Guttmann *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 22–34 (See N68-14823 05-21)

The horizontal situation display is proposed as a solution to the problem of providing rapid and intimate geographic orientation for a pilot. Several variations of the device, which is essentially a computer-servoed navigation chart, are described. These include the (1) direct view chart displays requiring the preparation of a series of special terminal charts which are inserted individually, and the roller map which uses a strip map representing a flight corridor; (2) projection displays using either a microfilm which is reproduced full scale on a rear projection screen, or one or several microchart chips which are inserted into a cylindrical chart carrier drum and can be exchanged conveniently; and (3) integrated displays which combine electronic cathode ray tube imagery of the immediate tactical environment as acquired by sensors with the navigational situation as represented by the computerized moving chart. The operational, logistic, and technological problems involved in preparing such charts are examined. The point is made that improved microchart photography depends on developing emulsions and processing techniques to attain the color contrast needed for a crisp color transparency. M.G.J.

N68-14826 Aeronautical Chart and Information Center, St. Louis, Mo.

AERONAUTICAL CHART REQUIREMENTS AND PRODUCTS

Robert R. Bard *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 35–39 (See N68-14823 05-21)

The need for user requirement data in developing cartographic products is discussed, and the factors affecting the type of product or data required are identified. These include the kind of mission involved, navigational techniques, navigational or guidance system components, weapon system capabilities, and environmental considerations. The consideration given to production factors is also discussed in terms of materials availability and the formulation of design criteria. Several examples of standard products are briefly described, such as the redesigned pilotage chart which reduces the number of charts that must be joined for a mission; the replacement of the world aeronautical chart by the operational navigation chart; the jet navigation chart with emphasis placed on features that have radar significance; and the B-58 chart developed to support a specific weapon system. Specialized cartographic support areas are also discussed, such as the preparation of computer programming tapes for navigating the F-106 between preselected points; the pictorial situation indicator which necessitates miniaturized cartographic products; and the flight log chart. M.G.J.

N68-14832 Naval Missile Center, Point Mugu, Calif.

NAVIGATION DISPLAYS AND EVALUATION OF CONTACT-ANALOG SYSTEMS

Paul E. Abbott *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 75–76 (See N68-14823 05-21)

The basic features of the contact analog display are defined as symbolic representations of real-world elements which move in proper scalar relationship to the actual vehicle and are anchored to their real-world referents. The vehicle is perceived and controlled in the vertical plane and is so depicted on a vertical cathode ray tube (CRT). The earth is perceived in the horizontal plane and is so depicted on the CRT. Consideration is given to the fundamental problem of local and remote control in which accurate orientation in the vertical or horizontal plane is necessary for interpreting depicted information in those planes, and vice versa. Among the methods proposed for improving navigator performance and balancing behavior are provisions for (1) an overall layout of the pilot; (2) look-ahead knowledge of spatial and deviation limits; (3) immediate knowledge of rate of travel and change of direction; (4) look-back information to see what's been accomplished; (5) confirmation of control action; and (6) a comfortable time scale in which to accomplish the work. M.G.J.

N68-14833 Computing Devices of Canada, Ltd., Ottawa (Ontario).

DESIRABLE DESIGN FEATURES PECULIAR TO A PROJECTED MOVING MAP DISPLAY

Donald W. Anderson *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 77–86 (See N68-14823 05-21)

Parameters peculiar to a projected map display are discussed in terms of raw materials, techniques, and the display features most suitable for satisfying user requirements. A film strip technique is used to provide effective communication from the computer to the operator; to permit the operator to orient his navigational information with the surrounding terrain; and to provide for a simple and efficient feedback from the operator to the computer. Problems relating to selecting paper maps, films, and reproduction methods are assessed. The projected film strip technique is considered to be ideal for the low-level tactical role, especially when the aircraft does not contain sophisticated sensors and fixing aids. The use of 1:500,000 pilotage charts and 1:2,000,000 JN charts as the basic paper maps is recommended. M.G.J.

N68-14834 Royal Aircraft Establishment, Farnborough (England). Instruments and Electrical Engineering Dept.

THE DEVELOPMENT OF TOPOGRAPHICAL NAVIGATION DISPLAYS IN THE UNITED KINGDOM

Kenneth R. Honick *In* Human Factors Res., Inc. Aeron. Charts and Displays Aug. 1967 p 87–97 (See N68-14823 05-21)

Early experiences in developing pictorial navigation displays are recounted, and flight test evaluations of the various devices are discussed. The parallel development of microfilming map areas in color is described, and the problems involved in combining the projected map image with the image of a cathode ray tube is examined. Consideration is also given to the modification of geometrical map projections during copying. The point is made that visual readout devices and microphotographic methods are directly applicable both to the translation of computer information into meaningful terms, and to the preparation, storage, and retrieval of cartographic data generally. M.G.J.

N68-14835 Naval Oceanographic Office, Washington, D. C.

CARTOGRAPHIC SUPPORT FOR AIRBORNE NAVIGATION DISPLAY SYSTEMS

William R. Campbell *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 98–101 (See N68-14823 05-21)

A checkoff list for display designers is presented on the more important cartographic design considerations that must be satisfied in any and all types of navigation displays. These are: (1) Standard charting series must be used. (2) The graphics must be readable. (3) The graphic must be in color. (4) The chart portrayal must be mostly of an area ahead of the aircraft. (5) There must be a choice of chart scale. (6) There must be a chart projection correction capability. (7) There must be a coding feature for updating aircraft position when shifting from one map frame to another. The required logistic support is discussed in terms of storage, distribution, maintenance, and updating which, in turn, involves data acquisition and collection, requirements determination, validation, and chart production. The point is made that the mapping and charting community cannot provide full color, miniaturized graphics on a production line basis to support the optical projection type of navigation. The need for close cooperation between government and industry for intensified research and development is stressed. M.G.J.

N68-14836 Hughes Aircraft Co., Culver City, Calif.

SOME THOUGHTS ON MAP DISPLAYS

Stanley N. Roscoe *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 102–106 (See N68-14823 05-21)

Map display usage is discussed generally, and four areas in which the display of stored information is of value to an aircrew are identified as assistance in (1) low altitude tactical navigation, particularly at night or in poor weather; (2) interpreting surface mapping radar or other high resolution, real time, imagery producing sensors; (3) updating self-contained navigation systems by reference to visual or radar position fixing and (4) initiating and interpreting inflight system self-test routines or performing the same tests on the ground. Critical design areas in map displays are discussed in relation to the information content, the rules for encoding information, and the way in which the display should be supported. Consideration is also given to the question of what constitutes an effective map display. M.G.J.

N68-14837 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
EXPERIMENTAL USE OF SEVERAL BRIEFING METHODS AS AIDS TO TARGET DETECTION WITH HIGH-RESOLUTION RECONNAISSANCE DATA
Don F. McKechnie and Leonard L. Griffin *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 107–116 refs (See N68-14823 05-21)

To provide insight into some problems of aeronautical charting and information display, four experimental studies of human performance in target detection with high resolution, side-looking radar were conducted. Standard aeronautical charts, specially prepared imagery, and previous coverage images of geographic areas of interest were used. The techniques of presenting the briefing information to an operator included hand-held, optically displayed, and cathode ray tube displayed data. The results indicate: (1) Image motion rates are not a limiting factor in target detection, and briefing material is effective in reducing the performance degradation attributable to high rates of image motion. (2) No one type of information within the range of materials studied is clearly or consistently more beneficial as briefing material. (3) The manner of presentation to the operator directly affects his target detection performance. M.G.J.

N68-14838 McDonnell Aircraft Corp., St. Louis, Mo. Engineering Psychology Section.
THE POSITIONING OF MAP NAVIGATION DISPLAYS IN AIRCRAFT COCKPITS: AN ANALYSIS OF REQUIREMENTS AND RESTRAINTS
Edward E. Eddowes *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 117–124 (See N68-14823 05-21)

In the requirements and restraints analysis, emphasis is placed on high performance aircraft of the fighter, attack, and reconnaissance type, and on the ordinary visual map navigation task of detecting and recognizing checkpoints along a preplanned course. Consideration is limited to the strictly visual case. The standard basic-six and basic-T cockpit display arrangements are depicted and discussed, along with several map–radar and map navigation displays, to illustrate the problems of optimum location. A possible rationale is suggested for solving the space problem by positioning a navigation display in the top center of the pilot's instrument panel in the same place as the attitude or intercept displays. M.G.J.

N68-14839 Autonetics, Anaheim, Calif.
SOME COMMENTS ON THE DISPLAY OF CARTOGRAPHIC INFORMATION FOR VERY LOW LEVEL FLIGHT
Robert H. Wright *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 125–132 (See N68-14823 05-21)

The characteristics of the information available for geographic orientation during very low level flight are summarized, and consideration is given to the cartographic display properties which would enable the pilot to use these data more effectively in navigating at low level. A systematic systems-oriented approach is recommended in which operational methods, cockpit design and vehicle performance, navigation system design and map display, desirable map characteristics, map production and distribution logistics, other users, and interservice and international coordination should be assessed in relation to defining maps or cartographic materials. M.G.J.

N68-14840 Royal Air Force, Farnborough (England).
BRIEF COMMENTS ON PROBLEMS IN THE OPERATIONAL USE OF AERONAUTICAL CHARTS AND MAP DISPLAYS
Michael J. C. Burton *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 133–135 (See N68-14823 05-21)

Aeronautical chart and map display requirements are discussed in terms of Royal Air Force operations. The need for competent preflight briefing of the aircrew is stressed, and the importance of adopting internationally acceptable standard specifications is emphasized. The major areas requiring further research and development efforts are listed. M.G.J.

N68-14841 Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
CHART REQUIREMENTS FOR LOW-ALTITUDE, HIGH-SPEED, MILITARY MISSIONS
Frank M. Pelton and Thomas R. Magorian *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 136–140 (See N68-14823 05-21)

The special demands on chart accuracy imposed by low altitude, high speed (LAHS) military mission planning are discussed, and a method of analyzing terrain–mission interaction is outlined. Consideration is also given to the problem of the navigation charts needs during LAHS flight. The primary types of required information are identified as (1) data regarding the planned route; (2) checkpoints which can be acquired and accurately located from the aircraft; and (3) general terrain shape and hydrologic information with significant, recognizable terrain features readily interpreted. Several areas requiring further investigation in developing LAHS flight maps are recommended. The point is made that visual navigation capability during LAHS flight is relatively poor, that the maps are a limiting factor, and that the map should be considered as a necessary part of the penetration system. M.G.J.

N68-14842 Rand McNally and Co., Washington, D. C.
A PROTOTYPE AIR NAVIGATION CHART: SOME NEW CONCEPTS IN AERONAUTICAL CHARTING
Richard R. Randall *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 141–145 (See N68-14823 05-21)

Details are given on a prototype aeronautical chart designed exclusively for the visual flight rules (VFR) pilot, and the development of graphic elements for delineating topographic information. Visual significance from the air was considered as a prime criterion in selecting and portraying all base detail. To illustrate the salient innovations, emphasis is placed on the preparation of the shaded relief plate, the hypsometric tints used to provide accurate information on the absolute evaluation of specific areas, typographic design, and symbology. Color compatibility and impact, and variations in screen values and line weights are assessed in terms of the resulting graphic enhancement. M.G.J.

N68-14846 Army Map Service, Washington, D. C. Development Engineering Div.
AUTOMATION, CYBERNETICS, MAPS, AND DISPLAYS
William C. Aumen *In* Human Factors Res., Inc. Aeron. Charts and Map Displays Aug. 1967 p 160–163 (See N68-14823 05-21)

A solution to the problem of navigation display is proposed based on the input of numerical map data to an electronic computer. The role of cybernetics in mapping and charting is defined as the determination of what part of the human automatic control system which detects, evaluates, and utilizes map information can be assumed by the computer system. It is pointed out that once the computer has solved the problem of the sequence of vehicle

control movements, automation can be instituted by including instrumentation to determine actual position along the path which would feed to a control device; the device, in turn, activates vehicle control movements to follow the correct path. Several ideas on how to use digitized topographic data for display purposes are discussed, along with the tasks of collecting and converting the map data to establish a digital topographic data bank. M.G.J.

N68-14847 Human Factors Research, Inc., Santa Barbara, Calif.
DISCUSSION GROUP 1. THE DEVELOPMENT AND VALIDATION OF AIRCREW NEEDS FOR AERONAUTICAL CHARTS AND NAVIGATION DISPLAYS Summary Report
In its Aeron. Charts and Map Displays Aug. 1967 p 172–173 (See N68-14823 05-21)

Validation requirements were classified as short-term measures in the form of combined pilot opinion and performance; and long-term measures, with a feasibility study conducted on the operational and cartographic problems associated with any new design feature of the aeronautical chart. Methods of determining user needs are reviewed, and it is pointed out that no new ideas on the subject were presented. Major problem areas were identified as the lack of communication between users, system designers, and cartographers; a poor appreciation of the lag time between the identification of user needs and their implementation of improvements; and a lack of coordination between data collecting agencies. Recommendations for meeting future requirements are proposed. M.G.J.

N68-14851 Human Factors Research, Inc., Santa Barbara, Calif.
DISCUSSION GROUP 5. THE ASSESSMENT OF MAP-DISPLAY SYSTEMS
In its Aeron. Charts and Map Displays Aug. 1967 p 182–188 (See N68-14823 05-21)

Three major ways of evaluating map-display systems are assessed: (1) opinion sampling, whereby the personnel who have been using or testing the equipment record their opinions on its performance; (2) theoretical or numerical analyses, involving the evaluation of the mechanical, optical, servomechanical, cartographic, electronic, and navigation portions of the system; and (3) empirical tests, using flight simulation techniques. The unavailability of adequate criteria is considered a major problem in assessing map–display systems. Examples of missing criteria are cited as the allowable number of disorientations per unit time, the distance from a preselected route, and the accuracy of locating targets of opportunity. Criteria which may prove of assistance are listed as legibility and visibility, accuracy, utility, flexibility, and ability to update cartographic materials, complexity, reliability logistics, compatibility, training requirements, installation problems, and cost effectiveness. M.G.J.

N68-14852 Human Factors Research, Inc., Santa Barbara, Calif.
DISCUSSION GROUP 6. TECHNOLOGICAL POSSIBILITIES IN MAP-DISPLAY SYSTEMS AND THEIR RESEARCH AND DEVELOPMENT IMPLICATIONS Summary Report
In its Aeron. Charts and Map Displays Aug. 1967 p 189–190 (See N68-14823 05-21)

Several promising approaches to display techniques are reviewed, such as the trend toward putting all information in digital form and the possibility of building an airborne display fed from a digital data bank. Changing needs, occurring as a function of the particular aircraft–crew–mission combination, are mentioned in relation to their effect on design. It is pointed out that an understanding of display requirements is somewhat less advanced than display system technologies. The recommendation is made that research and development efforts should be directed toward providing pilot performance criteria for selecting optimum designs for typical mission profiles. M.G.J.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-13954# Oak Ridge National Lab., Tenn.
CRITICAL EXPERIMENTS
In its Neutron Phys. Div. Aug. 1967 p 28–45 refs (See N68-13952 05-24)

Brief reports are presented on criticality experiments and related calculations. Among the areas of investigations are the following: criticality of aqueous solutions of uranium and uranium compounds; criticality of arrays with basic geometries; neutron decay; and calculations using the Monte Carlo method, Fortran, and other codes. N.E.N.

N68-13955# Oak Ridge National Lab., Tenn.
REACTOR AND WEAPONS SHIELDING
In its Neutron Phys. Div. Aug. 1967 p 46–82 refs (See N68-13952 05-24)

Radiation measurements and calculating methods are briefly described for various shielding materials. Emphasis was placed on determining neutron energy spectra, transport, and leakage, and on calculations using the Monte Carlo method and discrete ordinates. N.E.N.

N68-13975# Brookhaven National Lab., Upton, N. Y.
ON THE TRANSPORT OF FISSION-PRODUCT IODINE FROM MOLTEN URANIUM
I. N. Tang and A. W. Castleman, Jr. [1967] 3 p Presented at the ANS Meeting, Chicago, 5–9 Nov. 1967 Sponsored by AEC (BNL-11610)

The transport of volatile fission products in condensed and gas phases is discussed. The rate of transport across the vapor-liquid interface was expressed by the Langmuir equation for vaporization, generalized for nonideal multicomponent solutions. The experimental results on the release of fission product ^{131}I from molten uranium is presented with the emphasis on the elucidation of the release mechanism. NSA

N68-13991# Hanford Atomic Products Operation, Richland, Wash.
MULTI-PURPOSE REACTOR FUEL CHANNEL MONITORING SYSTEM
K. O. Creek May 1967 36 p Prepared for Douglas United Nucl., Inc.
(Contract AT(45-1)-1350)
(RL-GEN-929, Rev. 1; RL-SA-64) CFSTI: HC $3.00/MF $0.65

The process tubes of the N-Reactor are corrosion-resistant and thoroughly tested but may be subject to damage or deterioration.

Probes have been developed to assess process tube conditions in the reactor. A television probe visually examines the inner surface and measures pit or scratch depth. An ultrasonic hydride probe measures hydrogen content in the tube wall. An inner-diameter probe measures tube creep. Peripheral equipment is provided to clean and dry the tubes, and to insert the probes into the process tubes. Availability of this monitoring system will provide adequate surveillance of the integrity of the process tubes, thereby allowing replacement of the process tubes before reactor operating safety is diminished. Author (NSA)

N68-13995# Nuclear Materials and Equipment Corp., Apollo, Pa.

IRRADIATION TESTING OF PuO_2–UO_2 FUELS Quarterly Progress Report, 1 Apr.–30 Jun. 1967

Sep. 1967 14 p refs

(Contract AT(30-1)-3432)

(NUMEC-3432-35) CFSTI: HC $3.00/MF $0.65

The irradiation program of instrumented capsules containing PuO_2–UO_2 fuels having compositions of interest for fast breeder reactors and for Pu recycle in thermal reactors in described. Five capsules to be irradiated for periods ranging from 10,000 to 100,000 MWd/t have been fabricated. The objectives of the program are: evaluate the performance of fuel elements from coprecipitated PuO_2–UO_2 and pellets prepared by the mechanical mixing of the component powders; evaluate the differences in performance due to differences in pellet stoichiometry; determine the effect on performance of relavitely gross inhomogeneities from incomplete powder blending; and observe performance of fuel elements formed by vapor cementation with W of spherical particles composed of PuO_2–UO_2. Author (NSA)

N68-14001# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).

USE OF PLUTONIUM AS A FUEL IN NUCLEAR REACTORS Annual Report, Jan. 1–Dec. 31, 1965

Dec. 1966 71 p refs *Its* Spec. Rept.-6

(Contract EURATOM-001-64-1-TRUB)

(EURAEC-1884; EUR-3380) CFSTI: HC $3.00/MF $0.65

The preparation of vibrating mixed UO_2–PuO_2 powders is described. The fabrication of Pu rods and their irradiation in the Br-3/PWR reactor is discussed. A fuel assembly of the Br-3/Vulcain type, comprising 18 rods with 6% enrichment and 1 rod 5% enriched with fissile $^{239}Pu + ^{241}Pu$, was selected for assessment of Pu behavior in reactors. The study of the thermal behavior of UO_2–PuO_2 fuels in the BR-2 is described. Methods of determining the burnup ratio of fuels are examined. Dissolution and purification processes for plutonium are presented. NSA

N68-14012# National Reactor Testing Station, Idaho Falls, Idaho.

NUCLEAR TECHNOLOGY BRANCHES QUARTERLY REPORT, JANUARY 1–MARCH 31, 1967

W. C. Francis, D. R. De Boisblanc, and R. G. Fluharty Sep. 1967 48 p refs

(Contract AT(10-1)-1230)

(IN-1117) CFSTI: HC $3.00/MF $0.65

A program has been initiated to stabilize intercycle and intracycle neutron fluxes in the Engineering Test Reactor. The goal of this program is to limit the experiment neutron flux variations to ±10 percent from a standard value. A core of fuel elements containing a new combination of U-235 and boron has been tested in the ETR. The new combination of U-235 and boron was shown to reduce excess reactivity variations, thus controlling rod movement, by approximately 50 percent compared to currently used fuel elements. Seven ETRC flux runs have been made to study the effects of rod travel on power distribution in 500-g-element core. Author (NSA)

N68-14013# North Carolina State Coll., Raleigh. Nuclear Engineering Dept.

DIFFUSION OF RECOIL FISSION FRAGMENTS FROM SOLID SURFACES CALCULATED RELEASE CURVES

L. Daniel Mears and Thomas S. Elleman Aug. 1967 28 p refs

(Contract AT(40-1)-3508)

(ORO-3508-2) CFSTI: HC $3.00/MF $0.65

Tables and figures are presented which give the predicted fractions of recoil fission products released from spheres for different diffusion coefficients and heating times. The spheres are assumed to be heated at constant temperature following impregnation with fission recoils. The data cover sphere radii of 0.01, 0.10, and 1.0 cm, and materials of Al, CsI, graphite, stainless steel, UC_2, UO_2, and Zircaloy. NSA

N68-14026# Societe d'Etude de la Propulsion par Reaction, Villejuif (France).

DEVELOPMENT PROBLEMS OF A MOTOR FOR ISOTOPIC PROPULSION [LES PROBLEMES DE DEVELOPPEMENT D'UN MOTEUR POUR LA PROPULSION ISOTOPIQUE]

R. Besse 1967 33 p In FRENCH Presented at the ELDO Symp. on Propulsion, Paris, 10–12 Oct. 1967 Submitted for publication

(ELDO-SP(64)-19) CFSTI: HC $3.00/MF $0.65

Essential characteristics, applications and technology of radiothermal propulsion. The paper centers around development problems of an isotopic propulsion engine. Nuclear space safety requirements are considered. ESRO

N68-14064# Atomics International, Canoga Park, Calif.

SIMULATION OF REACTOR DYNAMICS. VOLUME 1: A DESCRIPTION OF AIROS II-A

R. A. Blaine and R. F. Berland 5 Sep. 1967 115 p refs

(Contract AT(04-3)-701)

(NAA-SR-12452, V. 1)

AIROS II-A solves the space-independent reactor kinetics equations and in addition provides for the determination of reactivity by solving the discretized equations which represent the spatial heat and mass transfer model for several fuel channels, including fuel melting, coolant boiling, and vaporization and burnout. In addition, variation of the film coefficient with flow is accounted for along with the provision for flow decay and afterglow heating. Scrams can be initiated by delayed signals from instruments which sense any quantity calculated; e.g., power, inverse period, or temperature. AIROS II-A is built of small modules or subroutines so that future modifications or additions can be made as better physical models are available. An initial temperature calculation has been incorporated for use on an input option. The input generation routine computes the conduction and convection coefficients for a nxm multichannel modal system with built-in tables of specific heat, density, conductivity, and viscosity for the common fuel, structure, and coolant materials. Similarly, other modifications can easily be made. Up to 400 feedback equations and 15 delayed neutron equations can be solved in addition to the prompt neutron equation. The numerical method is essentially a fifth-order method with automatic time-step variation to ensure the required accuracy with the minimum expenditure of computer time. Special provisions are made for startup problems resulting in 60% reduction in running time over conventional codes. Both printed and graphical output are provided. Any 90 of the feedback variables can be printed and/or displayed. In addition, the grouping of feedbacks on each CRT frame is under the user's control. Author (NSA)

N68-14094# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.

DESIGN, FABRICATION, AND IRRADIATION OF A SAXTON SPECIAL 9×9 ASSEMBLY

A. F. Mattis and D. R. McClintock May 1967 43 p refs
(Contract AT(30-1)-3269)
(WCAP-3269-59) CFSTI: HC $3.00/MF $0.65

A special 9×9 assembly was irradiated in the Saxton reactor to obtain statistically significant data on prototype designs and materials considered for use in a large plant chemical shim environment. The assembly operated as part of the reactor core for a total of 155 effective full-power days at a maximum heat flux of 525,000 Btu/hr-ft^2. The assembly experienced a peak burnup of ≈8,000 MWd/MtU and a corresponding fast flux exposure (>1 MeV) of 1.0×10^{21} nvt. In-pile performance was satisfactory and a visual examination revealed no anomalies. Exposure did not increase the force required to move the RCC absorber rods. Author (NSA)

N68-14129# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
FFTF PLUTONIUM FUEL DEVELOPMENT
B. R. Hayward 29 Sep. 1967 5 p Presented at Nuc. Met. Conf., Phoenix, Ariz.
(Contract AT(45-1)-1830)
(BNWL-SA-1434; CONF-671005-3) CFSTI: HC $3.00/MF $0.65

Design requirements and operating characteristics of the Pu fuel assembly of the Fast Flux Test Facility are reported. NSA

N68-14173*# General Electric Co., Idaho Falls, Idaho. Nuclear Energy Div.
CAVITY REACTOR GAS-CORE CRITICAL EXPERIMENT
J. F. Kunze, L. S. Masson, G. D. Pincock, R. E. Wood, and R. E. Hyland (NASA Lewis Res. Center) 6 Nov. 1967 20 p refs
(NASA Order C-67747-A; Contract AT(40-1)-2847)
(NASA-CR-72329) CFSTI: HC $3.00/MF $0.65 CSCL 18I

A gaseous (UF_6) core configuration was made critical to determine if an experimental bias was present to account for the discrepancy between measured and predicted critical mass. Results from the real gas configuration were compared with those from a mockup foil configuration of the identical dimensions. The system design and operating experience are described. As a result of the experiment, a new core mockup was assembled. It is concluded that this mockup provides an adequate representation of the gas core and can be used to study variations in materials and geometry that are difficult with the gas core. It is also concluded that a correction of the order of 9% should be applied to prior results to correct for fuel heterogeneity. N.E.N.

N68-14181# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
REACTOR IN-CORE REGENERATIVE NEUTRON DETECTORS Interim Development Report
C. N. Jackson, Jr. Oct. 1967 20 p refs
(Contract AT(45-1)-1830)
(BNWL-430) CFSTI: HC $3.00/MF $0.65

To circumvent the problems of rapid performance degradation and other limitations of nuclear reactor in-core neutron flux detectors operating at high thermal neutron flux levels, development of regenerative ^{234}U–^{235}U detectors is being conducted. The sustained, relatively constant sensitivity of two experimental detectors, inserted within the core of a Hanford plutonium production reactor, demonstrated that extension by a factor greater than ten in the useful in-core life can be achieved with a regenerative emitter material as compared to a typical fission chamber. The sensitivity remained within essentially 10% of a medium value throughout an exposure of 5×10^{21} nvt for a calculated optimum regenerative emitter formulation of about 10% ^{235}U and 90% ^{234}U. This performance is equivalent to more than ten years operation in a possible nuclear commercial reactor having a neutron flux level of 1×10^{13} nv. The detector sensitivity was about 1×10^{-13} A per nv for thermal neutron and about 8×10^{-13} A per R/hr for gammas with a chamber sensitive volume one inch in diameter by one inch in length. Noted reductions in chamber dielectric characteristics were attributed to deficiencies in the test chamber vehicle. Author (NSA)

N68-14193# Phillips Petroleum Co., Idaho Falls, Idaho.
STEP PROJECT Quarterly Technical Report, Apr.–Jun. 1967
K. A. Dietz, ed., S. G. Forbes, and T. R. Wilson Sep. 1967 73 p refs
(Contract AT(10-1)-205)
(IDO-17240) CFSTI: HC $3.00/MF $0.65

Variational synthesis techniques were used for calculation of a three-dimensional power distribution for start-of-life of the LOFT reactor. PDQ trial functions used in the TNTO2 code are discussed. Reactivity transients due to fission product poisoning are calculated. A LOFT blowdown analysis of dynamic hydraulic forces on reactor loop components is presented. A calculated fission product inventory for 20 hrs operation at 50 MW is tabulated. Effects of steam and radiation on elastomers were measured. Relative iodine sorption of materials under simulated LOFT conditions is given. The performance of the continuous–sampler–monitor spray scrubber was evaluated. An experimental verification of oscillatory pressure phenomena in LOFT is discussed. Processing of the LOFT semiscale blowdown data is discussed. Evaluation of a bare wire thermocouple for high temperature thermometry studies is discussed. Insulator materials for refractory metal thermocouples are evaluated. NSA

N68-14200# Atomic Power Development Associates, Inc., Detroit, Mich.
OSCILLATOR TESTS IN THE ENRICO FERMI REACTOR
A. E. Klickman, R. E. Horne, and H. A. Wilber Aug. 1967 145 p refs
(APDA-NTS-11)

The requirement of two oscillator rods was anticipated for making oscillator tests in the Enrico Fermi reactor—one rod for low power and the other for higher power. Prior to the tests, the oscillator rods were installed in the core and their worths were measured. The zero-power transfer function was measured by means of oscillator tests, using four measurement techniques. The reactor transfer function was measured at powers up to 111 MW(t) with the reactor in both manual and automatic control. The reactor stability was investigated, using the results of the oscillator tests, and it was stable under both modes of control. A simple amplitude criterion was used for the cases with the reactor in manual control and the Nyquist criterion was used for the cases with the reactor in automatic control. The feedback transfer function was extracted from the reactor transfer function data obtained at 67 MW(t) and 11 MW(t). The feedback contained a substantial component with a long time constant (several seconds), which was not anticipated. The transfer function of the automatic control system was also extracted and analyzed. Author (NSA)

N68-14218# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Radiochemie.
FABRICATION OF FUEL ELEMENTS FOR IRRADIATION IN THE EFFBR. PART 1: FUEL FABRICATION
Th. Dippel and K. H. Walther Mar. 1967 10 p Transl. into ENGLISH from German Rept. KFK-564
(EURFNR-318; KFK-564)

Techniques for fabrication of the fuel for irradiation in the EFFBR are outlined. Preliminary testing is discussed. NSA

N68-14222# General Electric Co., Idaho Falls, Idaho. Nuclear Energy Div.
PBF CRITICAL EXPERIMENT CONTROL ROD MEASUREMENTS
J. F. Kunze, F. L. Sims, R. E. Wood 10 Oct. 1967 37 p refs
(Contract AT(40-1)-2847)
(GEMP-560) CFSTI: HC$3.00/MF$0.65

The data and related information associated with control rod measurements conducted with the Power Burst Facility (PBF) Critical Experiment reactor system are presented. The data includes the critical water levels, incremental water worths, pulsed neutron generator results related to the various core geometries and control rod configurations. These results provide the means by which the control worths are determined. Author (NSA)

N68-14256 Societa Nazionale Metanodotti, Milan (Italy). Laboratori Riuniti Studi e Ricerche.
THEORETICAL RESEARCH ON THE NIL REACTIVITY METHOD (PCTR) [INDAGINE TEORICA SUL METODO DELLA REATTIVITA NULLA (PCTR)]
G. Ghilardotti, B. Montagnini, and E. Vigliano Brussels EURATOM Nov. 1967 155 p refs In ITALIAN; ENGLISH summary
(Contract EURATOM-086-65-12 TEGI)
(EUR-3637.I)

The research carried out satisfactorily proved the validity of the zero reactivity method, applied to natural uranium and graphite lattices. This research, however, showed up certain points that merited a detailed theoretical study, a summary of which is given in the present report. The chief problems studied are: Influence of the spectrum on the quantity of poison that produces a zero reactivity variation; spectral adjustment criteria; Internal buffer poisoning; most suitable choice of spectral index; flux flattening in the test zone; and correction of nitrogen absorption. Author

N68-14277# Oak Ridge National Lab., Tenn.
EFFECT OF UNIT SHAPE ON THE CRITICALITY OF ARRAYS
J. T. Thomas Oct. 1967 19 p refs
(Contract W-7405-ENG-26)
(ORNL-CDC-4) CFSTI: HC$3.00/MF$0.65

The known criticality of uranium metal enriched to 93 wt % in ^{235}U as subcritical cylindrical components in unreflected arrays is used to explore component geometry effects in such arrays. Three basic geometries are chosen; the cube, the sphere, and the cylinder with equal height and diameter. It is shown that the multiplication factor of a unit defines sizes of the three shapes useful in establishing critical arrays equivalent to a given reference array. The number of components and the average uranium density of the equivalent arrays are the same as the reference array. The effects of changes in average uranium density and component mass on the array multiplication factor are investigated. Author (NSA)

N68-14321# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
SOME CONSIDERATIONS ON GAS COOLING FOR FAST BREEDERS
M. Dalle Donne, E. Eisemann, and K. Wirtz May 1967 15 p refs Sponsored by US–EURATOM
(KFK-595; EURFNR-367) CFSTI: HC$3.00/MF$0.65

The use of He and CO_2 as coolants for fast breeder reactors is examined from the standpoint of recent technical improvements in components and materials necessary for the development of such reactors. The development of prestressed concrete pressure vessels, the use of roughened fuel element surfaces, the development of V-alloys with good high temperature properties for fuel cladding, and improvements in gas turbines are briefly discussed, and the technical factors involved in the choice of He or CO_2 as coolant are examined. NSA

N68-14363 Case Inst. of Tech., Cleveland, Ohio.
REACTIVITY CHANGES OF A FAST REACTOR CORE DUE TO ELASTIC PLASTIC STRAIN AND CREEP
Richard L. Puthoff (M.S. Thesis) 1967 75 p refs

A method is presented for analyzing the gross core structural changes of a small compact fast reactor. The method is applied to a fast reactor containing tungsten UO_2 fuel elements. Core reactivity changes during start up and full power operation of the reactor are calculated. Author

N68-14357# Atomics International, Canoga Park, Calif.
HEAVY WATER ORGANIC COOLED REACTOR. DEVELOPMENT OF A STAINLESS STEEL–ALUMINUM TRANSITION JOINT FOR HIGH-TEMPERATURE SERVICE
W. R. Jackson 25 Sep. 1967 32 p refs
(Contract AT(38-1)-430)
(AI-CE-72) CFSTI: HC$3.00/MF$0.65

A stainless steel–aluminum transition joint for use at elevated temperatures has been developed. The joint consists of a stainless steel tubular section metallurgically bonded to an aluminum sleeve by hot isostatic pressure bonding. A tungsten barrier layer is incorporated to prevent diffusion between the stainless steel and aluminum components. The transition joint was developed to provide a means to penetrate the aluminum alloy end plugs of SAP-clad, UC fuel rod assemblies with instrument leads. These fuel rod assemblies were fabricated in support of the Heavy Water Organic Cooled Reactor (HWOCR) Program. Transition joints have been fabricated and have allowed fuel centerline temperatures and fission gas release data to be obtained from HWOCR irradiation experiments for in-pile operating periods >10,000 hr. More than two hundred transition joints have been fabricated and utilized in determining the long-term, stress-rupture properties of irradiated and unirradiated SAP cladding. Author (NSA)

N68-14367# Kernforschungszentrum, Karlsruhe (West Germany).
PHYSICS INVESTIGATIONS OF A 670 l STEAM COOLED FAST REACTOR SYSTEM IN SNEAK, ASSEMBLY 3A-1
L. Barleon, A. Bayer, R. Boehme, K. Boehnel, K. Burkart et al Oct. 1967 47 p refs Sponsored by EURATOM
(KFK-627; SM-101/11; EUR-3671.E)

Steam cooled fast reactors in the 100 MWe range are studied. This series started in May 1967 with the critical experiment of SNEAK 3A-1, a 670 l uranium system containing 7.41×10^{20} atoms/cm^3 of hydrogen in the form of polyethylene foils. The neutron energy spectrum has been measured by various methods from the eV-region to over 1 MeV in the core center and at the periphery, reaction rates have been measured in the center and in axial and radial traverses, the initial breeding ratio and the reactivity worth of selected materials have been determined. Measurements of the Doppler reactivity effect, the steam void effect and of β/l have been performed. Special effort was devoted to the experimental investigation of heterogeneity effects. The experimental results are compared with calculations using the 26 group ABN set and a specially prepared 26 group cross section set KFK-SNEAK using latest cross section information and the SNEAK-3A spectrum as a weighting spectrum. The heterogeneity results are compared with theoretical models including space dependent resonance self-shielding. Author

N68-14432# New Mexico Univ., Albuquerque. Dept. of Electrical Engineering.
COMPUTATION OF OPTIMAL CONTROLS FOR A NUCLEAR ROCKET REACTOR
H. J. Price and R. R. Mohler Sep. 1967 32 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.
(Contract AT(29-1)-789)
(SC-CR-67-2723) CFSTI: HC $3.00/MF $0.65

Various optimal reactor control problems with complicated constraints are solved for a nuclear rocket engine. The technique utilizes a digital computer with the numerical algorithm formed by a succession of linear programming problems. Each programming problem has a solution which is used to relinearize the system's dynamical equations. Author (NSA)

N68-14433# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
OPTIMAL NUCLEAR REACTOR CONTROL Final Report
R. R. Mohler and H. J. Price Aug. 1967 162 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.
(Contract AT(29-1)-789)
(SC-CR-67-2746; EE-142) CFSTI: HC $3.00/MF $0.65

Topics discussed include: theoretical aspects and numerical calculation of optimal controls with the maximum principle for the nuclear rocket reactor; potentially singular subarcs for the nuclear rocket reactor; and linear programming with MPS 1360. NSA

N68-14439# AEG-Kernenergieanlagen, Frankfurt am Main (West Germany).
STUDIES ON CYCLONES FOR STEAM SEPARATION IN BOILING-WATER REACTORS Annual Report
Faerber Vollradt, comp. 1966 106 p refs *Its* Spec. Rept.-1
(Contract EURATOM-083-66-ITEED)
(EURAEC-1898; EUR-3390) CFSTI: HC $3.00/MF $0.65

For technical reasons relating to the reactor the coolant in boiling-water reactors must be as free of bubbles as possible when it flows back into the downcomer space. A steam quality of $x \leq 0.2\%$ is usually admitted. In reactors of over 60 MWe the natural effect of gravity is no longer sufficient for steam separation purposes and centrifugal separators have to be fitted if the separation process is to take place inside the pressure vessel. For the Lingen nuclear power plant, AEG developed special gravity-type cyclones which are mounted in the downcomer space and are hoped to be an improvement on other forced-separation systems from the operational and economic angle. This 160 MWe reactor, in which the circulation is regulated down to 25% partial load, is fitted with 88 cyclones with an inner diameter of 170 mm and a length of about 3.4 m, into which the coolant flows tangentially. These give an additional pressure drop of 0.42 atm at the circulating pumps. The extent to which the results of air/water tests can be transferred to reactor conditions is determined. Comparison of the data obtained with air/water and steam/water experiments show that the majority of preliminary tests can be performed with the less complicated air/water mixtures. The tangential inflow of the cyclones was changed into axial ingress from above, so that the inlet chambers are no longer required. Appropriate air/water tests show that the functioning of the individual cyclones is not adversely affected by this, but experiments with two cyclones of this type switched in parallel show that the mixture distribution to cyclones which are mounted at various distances from the reactor core is still unsatisfactory. Author (NSA)

N68-14482# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
YANKEE CORE EVALUATION PROGRAM Quarterly Progress Report, Period Ending Jun. 30, 1967
M. J. O'Boyle Oct. 1967 56 p refs
(Contract AT(30-1)-3017)
(WCAP-6085) CFSTI: HC $3.00/MF $0.65

Results of mass spectrometric determination of ^{137}Cs content in Yankee core fuel samples are listed. Analyses of fuel burnup samples for ^{236}Pu and ^{238}Pu are presented. Americium and Curium content in fuel burnup samples is given. Use of the LASER computer code for burnup analyses is discussed. The mathematical formulation of the LASER program is developed. Burnup sample analyses atom percents and mass ratios of ^{235}U, ^{236}U, and Pu are tabulated. The evaluation of the ^{148}Nd burnup indicator is discussed. NSA

N68-14483# Aktiebolaget Atomenergi, Stockholm (Sweden).
MEASUREMENTS OF HYDRODYNAMIC CHARACTERISTICS, INSTABILITY THRESHOLDS, AND BURNOUT LIMITS FOR 6-ROD CLUSTERS IN NATURAL AND FORCED CIRCULATION
O. Nylund, K. M. Becker, R. Eklund, O. Gelius, I. Haga et al Jun. 1967 158 p refs
(FRIGG-1)

As a first step in the 8 MW FRIGG loop project for full scale tests on simulated water reactor fuel elements, a series of experiments were performed in the 2.5 MW FROJA loop with 6-rod clusters, simulating the central region of a boiler channel for the Marviken boiling heavy water reactor. The purpose of these experiments, and the 36-rod tests now being performed is the FRIGG loop, is verifying that the Marviken reactor can be operated at the rated power with proper safety margins against burnout or instability. The experiments are establising an experimental basis for calculation methods to be used for future reactions. The 6-rod clusters consisted of rods with 4.4 m uniformly heated length and 13.8 mm outer diameter. Prototype reactor spacers were used. The investigations include the single and two-phase pressure drop, the axial and radial void distribution, burnout in natural and forced circulation, the natural circulation mass velocity, the stability limit as well as the details about the system during transient conditions. Author (NSA)

N68-14491# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
BUCKLING ANALYSIS OF REACTOR CORES. PART 6: THE METHOD OF SOLUTION-FUNCTIONS EXTENDED FROM ρ–θ TO ρ–ϕ AND ρ–θ–ϕ CYLINDRICAL GEOMETRIES
Renato Bobone 3 Jan. 1967 18 p Presented at the 15th Conf. on Remote Systems Technol. and Atom Fair, Chicago
(Contract W-31-109-ENG-52)
(KAPL-P-3381; CONF-671102-23) CFSTI: HC $3.00/MF $0.65

A method of computerized solution to the one-group diffusion equation for multiregion reactors in ρ–ζ geometry and ρ–θ–ζ geometry is given. Neutron flux calculations are shown as a function of reactor core radius. NSA

N68-14494# Babcock and Wilcox Co., Lynchburg, Va.
PHYSICS VERIFICATION PROGRAM, PART 2 Quarterly Technical Report, Apr.–Jun. 1967
R. H. Clark and M. N. Baldwin Sep. 1967 27 p refs
(Contract AT(30-1)-3647)
(BAW-3647-5) CFSTI: HC $3.00/MF $0.65

In-core and out-of-core measurements on startup detectors for pressurized-water reactors are described. Studies of characteristics of an all-solid self-powered in-core detector in a critical assembly are discussed. Core parameters and configurations are detailed. NSA

N68-14536# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik.

INVESTIGATION ON CHARGE 2 OF THE FAST THERMAL ARGONAUT REACTOR STARK [UNTERSUCHUNGEN AN DER LADUNG 2 DES SCHNELL-THERMISCHEN ARGONAUT-REAKTORS STARK]

L. Barleon, A. Bayer, Chr. Brueckner, K. Burkart, D. Kuhn et al Jun. 1967 92 p refs In GERMAN
(KFK-592)

A description of the second core loading of the fast-thermal reactor STARK is given. Critical experiments, flux and power distribution measurements, spectral measurements in the fast zone, reactivity measurements in the fast and thermal zones, and kinetic measurements using the pulse methods are discussed. Results are presented graphically, and are discussed at length. Multigroup calculations are described. NSA

N68-14585*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PARAMETRIC ANALYSIS OF RADIOISOTOPE CASCADED THERMOELECTRIC GENERATORS

James T. Ward and Robert Ruch Washington Jan. 1968 27 p refs
(NASA-TM-X-1501) CFSTI: HC $3.00/MF $0.65 CSCL 18B

The generator consisted of a high-temperature silicon–germanium first stage and a lower-temperature lead telluride second stage was placed concentrically around a cylindrical fuel block. Heat was rejected from the outer surface of the generator shell; in most cases, fins were required to augment the heat rejection. The Si–Ge hot-junction temperature range was 1089° to 1255°K. The PbTe hot-junction temperature was fixed at 811°K and the PbTe cold-junction temperature varied from 422° to 700°K. The fuel-block length-diameter ratio varied from 0.5 to 10.0. The fuel-block-volume power-density range was 0.5 to 10.0 watts per cm^3. The generator power output was fixed at 250 watts electric. The performance of cascaded generators is also compared with the performance of single-stage Si–Ge generators. The results indicate that the cascaded generator operating at a Si–Ge hot-junction temperature of 1089°K had a minimum specific weight of 220 lbs per kilowatt electric (kW_e) at an efficiency of nearly 7%. For a Si–Ge hot-junction temperature of 1255°K, the minimum specific weight was 170 lbs per kWe with an efficiency of over 8%. The single-stage Si–Ge generator with a hot-junction temperature of 1255°K had a minimum specific weight of 100 lbs per kWe at an efficiency slightly below 6%. Author

N68-14589# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung.

SODIUM BOILING AND FAST REACTOR SAFETY

W. Peppler, E. G. Schlechtendahl, G. F. Schultheiss, and D. Smidt [1967] 24 p refs /ts Transl. of Rept.-612
(EURFNR-353; Rept.-612)

For fast Na cooled reactor safety analysis liquid metal superheat and coolant flashing is very important. Investigation of the ejection mechanism with the digital code BLOW shows good agreement with experimental results. Present knowledge on Na superheat is reviewed and discussed, especially to demonstrate the great differences in experimental data; from this a research program is established. Also recondensation effects with their high pressure peaks are investigated; theoretical and experimental results are presented. Author (NSA)

N68-14594# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.

ENGINEERING AND METALLURGICAL EVAUATION OF THE YANKEE CORE 1 SPENT FUEL

E. Paxson and W. R. Smalley Jun. 1967 147 p refs
(Contract AT(30-1)-3017)
(WCAP-604) CFSTI: HC $3.00/MF $0.65

The engineering and metallurgical evaluation of spent fuel from Core I of the Yankee Reactor was a portion of the Yankee Core Evaluation Program. The general purposes of the evaluation were to confirm the suitability of the design and materials used, to determine the irradiation stability of the core components, and to compare predicted with actual performance. Sixteen fuel assemblies were subjected to visual and dimensional examinations and 71 fuel rods from these assemblies were subjected to various visual, dimensional, and metallographic examinations, and mechanical property tests. Evaluation of the results of these examinations led to the following basic conclusions: (a) The overall performance of the Yankee Core I fuel assemblies was excellent. (b) The fuel assemblies and fuel rods were dimensionally stable even for extended exposure to peak burnups of 40,000 MWD/MTU. (c) The UO_2 fuel and Type 384 stainless steel cladding performed satisfactorily up to 46,000 MWD/MTU and neutron doses to 8×10^{21} n/cm^2 (>1 MeV). (d) None of the changes in the dimensions or properties of the fuel assemblies, cladding or fuel were sufficiently large to define any operational limits for fuel assemblies in environments similar to that in Yankee. Author (NSA)

N68-14663# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

BEHAVIOR OF DISPERSED NUCLEAR FUELS AT HIGH TEMPERATURE WITH REGARD TO THE FISSION PRODUCTS [COMPORTEMENT DES COMBUSTIBLES DISPERSES DE HAUTE TEMPERATURE VIS-A-VIS DES PRODUITS DE FISSION]

Miguel Ortega Jul. 1967 24 p refs
(CEA-BIB-86)

The main properties and processes for the fabrication of dispersed fuels formed by coated fuel particles contained in a moderating matrix are summarized. Since this new type of nuclear fuel is intended to work at very high temperatures, the problem of retention of fission products presents a fundamental interest. The knowledge gained in this field during the last few years and the solutions proposed for resolving this complicated problem are reviewed. Author (NSA)

N68-14681# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Kernphysik.

REVIEW OF SCATTERING LAW STUDIES FOR MODERATORS

W. Glaeser Jul. 1967 34 p refs Presented at the IAEA Symp. on Neutron Thermalization and Reactor Spectra, Ann Arbor, Mich., 17–21 Jul. 1967
(KFK-602; CONF-670707-17)

Scattering law studies for moderators are presented. The various forms of the law consider the effects of chemical binding on slow neutron scattering. The basic formalism is reviewed; integral properties are presented. Experimental techniques are outlined. Applications of various scattering kernel models are made to water, ZrH, graphite and Be moderators. 77 references. NSA

N68-14687# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

LIFE EFFECTS ON THE PERFORMANCE OF CERAMIC FAST BREEDERS

A. Gandini, M. Leo, and M. Salvatores 1967 15 p refs
(RT/FI-(67)23)

The sodium void coefficient, the Doppler effect and the prompt neutron lifetime calculations for the oxide pancake and the carbide system fast ceramic reactors are presented. The use of multigroup diffusion methods and generalized perturbation techniques are described. NSA

N68-14703# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
PERTURBATION ANALYSIS OF FAST REACTORS BY THE CIAP AND GLOBPERT CODES USING IMPROVED PERTURBATION METHODS
A. Gandini, M. Salvatores, G. Sena, and I. Dal Bono 1967 25 p refs Presented at the Intern. Conf. on Fast Critical Expt. and Their Analysis, Argonne, Ill.
(RT/FI-(67)16; CONF-661019-11)

New techniques for perturbation analyses are presented. Some applications of these techniques are outlined. In the multigroup diffusion approximation method, the CIAP code for calculation of the importance function as a function of specified linear variables; the GLOBPERT code uses this importance function in the perturbation formulations. An application to fast reactor systems is presented; calculations for Na void coefficient, Doppler coefficient, and total and internal breeding ratios are performed. NSA

N68-14712# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.
EVESR NUCLEAR SUPERHEAT FUEL DEVELOPMENT PROJECT Quarterly Report (Final), Mar.–Jun. 1967
Jul. 1967 40 p
(Contract AT(04-3)-189)
(GEAP-5485; QR-20) CFSTI: HC $3.00/MF $0.65

An overall listing of the EVESR is presented. Fuel rod failures are tabulated; off-gas activity from failed EVESR fuels is listed. Total fuel exposure is given. Each design and development stage of EVESR fuels is discussed briefly. NSA

N68-14730# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
NEFIRS: A COMPUTER PROGRAM FOR EXPLORATORY STUDIES OF NEUTRON FLUX DISTRIBUTIONS IN REACTOR SHIELDS
C. A. Goetzmann 18 Aug. 1967 70 p refs
(Contract AT(04-3)-167)
(GA-8069) CFSTI: HC $3.00/MF $0.65

NEFIRS (neutron fluxes in reactor shields) is a one-dimensional computer program based upon the principles that the neutron population of a region outside a reactor core is determined by the high-energy fission neutrons escaping from the core. The code, written in FORTRAN IV, consists of five basic sections of a main program. These sections are: (1) a routine to determine the spatial variation of the uncollided flux in the shield resulting from fission sources within the core, (2) a routine that computes from a library of basic data the neutronic constants necessary for an eight-group diffusion calculation through the various layers of structural or shielding materials surrounding the core, (3) a routine to solve the one-dimensional diffusion equation for a multilayer shield arrangement in one of the three standard geometries, (4) a library containing the basic data for up to twenty shield materials, and (5) a routine to evaluate the second-order exponential integral used in the analytic evaluation of the spatial distribution of the uncollided flux. Author (NSA)

N68-14738 AEG-Kernenergieanlagen, Frankfurt am Main (West Germany).
TWISTED TAPE BOILING WATER REACTOR Final Report, Jul. 1965–Sep. 1966
Brussels EURATOM Nov. 1967 111 p refs Prepared jointly with Soc. Natl. d'Etude et de Construct. de Moteurs d'Aviation
(Contract EURATOM-070-65-7-TEEC)
(EUR-3651.E)

Feasibility and economy studies of a 600 MWe Twisted Tape (TT) Boiling Water Reactor (BWR) first indicated that an appreciable gain on the kWh cost can be expected for a core power density of about 60–70 kW/l. To clarify technological problems and to gain information about basic thermal-hydraulics phenomena, an in-pile experiment was prepared with TT prototype fuel elements in the BWR at Kahl, Germany. Calculations using critical heat flux correlations and experimental results on TT clusters proved the safety of such an experiment. The bundle was manufactured without difficulties, and valuable knowledge has been gained on TT cluster manufacturing. To study TT corrosion behavior in a BWR, an out-of-pile experiment was conducted with a nine-rod TT bundle. The results were encouraging, especially as concerns fretting corrosion. Thermal tests included critical heat flux measurements on a four-rod bundle with the TT at inlet conditions (high subcooling). The results agree with those obtained during earlier tests. K.W.

N68-14740# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.
FAST REACTOR MELTDOWN ACCIDENTS USING BETHE–TAIT ANALYSIS
R. A. Meyer, B. Wolfe, N. F. Friedman, and R. Seifert Jan. 1967 85 p refs
(Contract AT(04-3)-189)
(GEAP-4809) CFSTI: HC $3.00/MF $0.65

The energy release from a meltdown accident is examined with reference to a 1000 MW(e) fast ceramic-fueled power reactor. Various reactivity insertion rates or reactivity steps are assumed, and the energy release as a function of the reactor parameters is investigated to determine the importance of these parameters and the sensitivity of the results to the assumptions that must be made. Specific parameters considered are Doppler coefficient, neutron lifetime, pressure–energy relationship for the fuel, core composition, power flattening, specific heat of the fuel, core shape, and initial conditions at the start of the reactivity input. Author (NSA)

N68-14764# Oak Ridge National Lab., Tenn.
FAST FUEL ELEMENT TESTING REACTOR (P.E.C.). PRELIMINARY DESIGN STUDY, SECTION 1
P. Aiello, P. Amadesi, P. Azzoni et al 31 Jul. 1966 80 p Transl. into ENGLISH of Comitato Nazl. per l'Energia Nucl., Bologna, Italy, Sect. 1 of ARV-66-45
(ORNL-TR-1786; ARV-66-45, Sec. 1) CFSTI: HC $3.00/MF $0.65

The preliminary design study for the Fast Fuel Element Testing Reactor (P.E.C.) is presented, and topics discussed include: irradiation facilities; reactor core; containment vessel; shielding; cooling system; fuels; and instrumentation. NSA

N68-14794 Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik.
REACTIVITY COEFFICIENTS OF STEAM COOLED FAST BREEDERS
E. Kiefhaber Oct. 1967 23 p refs Presented at the Symp. on Fast Reactor Phys. and Related Safety Probl., 30 Oct.–3 Nov. 1967 Sponsored by EURATOM
(KFK-629; SM-101/15; EUR-3673.E)

The influence of design parameters on the Doppler coefficient of criticality and the steam-density coefficient of criticality was investigated. Among the parameters studied are the following: plutonium composition; use of Incoloy 800 in place of Inconel 625; use of D_2O instead of H_2O; UN and PuN used stead of UO_2 and PuO_2; doubling the geometric buckling; the stability behavior of the group cross section sets; percentage D_2O content; increase of burn-up; decrease of fuel density; decrease of steam density; and increase of coolant volume fraction. The resulting data are tabulated and graphed, and the influences on the reactor behavior are discussed. N.E.N.

N68-14904 Gesellschaft fuer Kernforschung M. B. H., Karlsruhe (West Germany). Inst. fuer Angewandte Reaktorphysik.

OPERATIONAL CHARACTERISTICS AND RELATED DESIGN FEATURES OF SNEAK

W. Bickel, P. Engelmann, H. Watze, and G. Wittek Oct. 1967 31 p refs Presented at the Symp. on Fast Reactor Physics and Related Safety Problems, Karlsruhe, W. Germany, 30 Oct.–3 Nov. 1967

(KFK-632; SM-101/6; EUR-3676.E)

Details are presented on the safety and experimental instrumentation and control of the fast zero power reactor (Sneak), which is used to investigate the neutron physics of large fast reactors with uranium and/or plutonium fuel. The design was aimed at maximum flexibility and operational safety, and a vertical fixed suspended version was chosen in which the fuel elements are suspended from a grid and the loading is performed from below. Operational characteristics are discussed in relation to temperature behavior with and without cooling of the core, measurements of reproducibility in reactivity, and dose rates. Time requirements for experiments and loading changes are listed. M.G.J.

N68-14940# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.

YANKEE CORE EVALUATION PROGRAM Semiannual Progress Report, for Period Ending 31 Mar. 1967

Aug. 1967 83 p refs

(Contract AT(30-1)-3017)

(WCAP-6083) CFSTI: HC$3.00/MF$0.65

A recently approved extension of the Yankee Core Evaluation Program was initiated to determine experimentally and analytically the concentrations of many isotopes of interest in spent Yankee fuel which were not determined during earlier phases of the program. The buildup of ^{232}U and ^{233}U and their precursors is being investigated so that radiation problems involved in the enrichment of spent fuels can be better anticipated and planned for. The buildup of transuranic isotopes of economic value as fuel for isotopic power generators, such as ^{238}Pu and ^{244}Cm and their precursors is being studied to develop information needed for a complete evaluation of the feasibility and economic merits of using fuel discharged from commercial power reactors as a source of supply. Finally, the concentration of the stable fission product ^{148}Nd is being measured in spent Yankee fuel to determine if it is practical to use this isotope as a means of estimating fuel burnup with improved accuracy and precision. Author (NSA)

N68-14988*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ESTABLISHING ALLOWABLE TEMPERATURE GRADIENTS FOR TUNGSTEN–URANIUM DIOXIDE FUEL ELEMENTS USING EXPERIMENTAL CYCLIC STRAIN DATA

Ivan B. Fiero Washington Jan. 1968 36 p ref

(NASA-TN-D-4279) CFSTI: HC$3.00/MF$0.65 CSCL 18J

To establish allowable limits for temperature difference in tungsten–uranium dioxide fuel elements, experimental thermal strain data were examined. The data were obtained by uniformly heating tungsten and tungsten–uranium dioxide composites for 50 thermal cycles. Since the materials were not cycled to failure, the allowable temperature differences established from the experimental data are not absolute maximum values, but represent design values with which fuel element configurations can be evaluated. These allowable temperature differences are those which would produce thermal strains equivalent to the experimental data. If the strains calculated for a given design are less than the experimental values, the fuel element should operate satisfactorily under the conditions considered. Author

N68-14988 United Kingdom Atomic Energy Authority, Harwell (England). Research Reactors Div.

THE PHYSICS OF THE SUPERBOOSTER

G. Constantine, V. S. Crocker, R. H. Jones, M. J. Poole, A. H. Robinson, et al Jun. 1967 80 p refs

(AERE-R-5205) HMSO: 10s

The physics aspects of the superbooster are treated, including the kinetics of the core power under conditions of varying reactivity in response to different lengths of linac pulse. The time-dependent neutron spectra emerging from the moderator boxes are also calculated and normalised to steady-state flux distributions computed by standard multigroup diffusion-theory methods. The report gives fluxes available at the output faces of the moderator chamber and pulse lengths for a number of spot neutron energies under a wide range of conditions of linac pulse length, superbooster multiplication, pulse repetition frequency, and size and temperature of moderator chamber. An experimental program mounted in the fast critical assembly VERA is described and the results are presented. Thermal fluxes measured in a small boron-covered polythene block adjacent to the core to simulate a moderator chamber are compared with those calculated; agreement to within a factor of two is obtained, the measured values being higher than those calculated. Finally, calculated distributions of nuclear heating in structure, reflector, target, moderator, and boron-10 lining of the moderator boxes are given and preliminary estimates made of the thickness and materials of the biological shielding. It is concluded that the superbooster offers facilities for producing neutron pulses of far greater intensity and source area than can be foreseen by the use of conventional research reactos and neutron choppers, and it has particular advantages in the low-eV region. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-13922 Joint Publications Research Service, Washington, D. C.

CALCULATIONS OF THE HEIGHT OF VENTILATION STACKS FOR DISCHARGING AIR CONTAMINATED WITH RADIOACTIVE MATERIALS

V. M. Krupchatnikov 11 Jan. 1968 16 p refs Transl. into ENGLISH from Vodosnabzh. i Sanit. Tekhn. (Moscow), no. 10, 1967 p 30–34

(JPRS-43977) CFSTI: $3.00

Two formulas used for calculating discharge height are assessed, and it is pointed out that these results reflect the instantaneous relationship between concentrations at the point where the aerial jet touches the ground and the discharge. However, this relationship can only be true at a constant wind velocity and

direction which, under practical conditions, are not constant. A correction is introduced in order to observe the requirement that no individual's norm of daily intake of radioactive material be exceeded. An example is given to show that when determining stack height on the basis of the critical wind velocity, it is reasonable to use the average discharge per second during the entire normalized period, including emergency discharges. M.G.J.

N68-13923 Joint Publications Research Service, Washington, D. C.

METHOD FOR OBTAINING LIGHT AND SOUND IMAGES

Lazar Davydovich Rozenberg 11 Jan. 1968 12 p Transl. into ENGLISH from Chapter 4 of the booklet "The Story of Inaudible Sound" Moscow, Acad. Sci. USSR, 1961 p 90–106
(JPRS-43987) CFSTI: $3.00

A method is described by which high frequency ultrasonic oscillations can be made to propagate in the form of narrow and directed beams and thereby produce sound images of optically nontransparent objects. An acoustic lens is used with the material selected so that sound is propagated in it at a velocity smaller than in the surrounding medium. The angles of refraction are always larger than the angles of incidence; at the outlet boundary of the lens the sonic beams are refracted, become deflected from the perpendicular lines passing through the points of refraction, and converge. A clot of acoustic energy, whose shape images the shape of the object, is produced on the focal surface of the lens. Different methods for the visualization of this image are discussed, including surface relief, defectoscope, suspensions, photodiffusional, and mosaic techniques. M.G.J.

N68-14007# Technische Hogeschool, Eindhoven (Netherlands).

ON A NEW TYPE OF X-RAY GENERATOR

W. J. H. Beekman 14 Nov. 1967 59 p refs

The principle of the described X-ray generator is a variation upon the direct-current inductor, the grid-controlled X-ray tube itself acting as the interrupter. The anode of the X-ray tube was connected to a constant-voltage generator via a high-inductance coil. The capacitance was constituted by the sum of the capacitances of the tube, the leads and the coil. The main feature of the X-ray tube is the electron gun, consisting of a multi-grid construction of the Pierce type and a dispenser cathode with a concave emitting surface. The tube current was controlled by variation of the accelerating-grid voltage. By applying periodically a negative voltage pulse of rectangular wave form to the accelerating grid the capacitance was loaded at a low voltage and discharged at a high voltage alternately. The main data are: maximum voltage 250 kV, maximum tube current 300 mA, repetition frequency about 1100 c/s, discharge time about 50 μs. Author

N68-14084 Joint Publications Research Service, Washington, D. C.

RAY STATISTICS IN A LAMINAR MEDIUM WITH RANDOM INHOMOGENEITIES

V. M. Komissarov 11 Jan. 1968 14 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 9, no. 2, 1966 p 292–301
(JPRS-43978) CFSTI: $3.00

The process of wave propagation in a medium with regular and random inhomogeneities is described using the Fokker–Planck equation. The space angular distribution function for the ray is obtained, and fluctuations in the angles of incidence and the ray displacement are computed. The analogy between ray propagation and the translational motion of a Brownian particle in an external force field is illustrated. Author

N68-14132# Iowa State Univ. of Science and Technology, Ames.

THEORY OF PRISMATIC CROSS-SLIP OF DISLOCATIONS IN THE VICINITY OF PRECIPITATIONS [THEORIE DER PRISMATISCHEN QUERGLEITUNG VON VERSETZUNGEN IN DER UMGEBUNG VON AUSSCHEIDUNGEN]

H. Gleiter Jul. 1967 15 p refs Transl. into ENGLISH from Acta Met., v. 15, Jul. 1967 p 1213–1221
(IS-TRANS-71) CFSTI: HC $3.00/MF $0.65

A new mechanism of prismatic cross-slip is theoretically deduced. It is shown that the Orowan process for coherent strained precipitations is not, as previously assumed, a complete bypass mechanism, but rather it represents the first stage of prismatic cross-slip. Author (NSA)

N68-14189# Occupational Health Research and Training Facility, Cincinnati, Ohio.

LOCATION-DESIGN NOISE CONTROL OF TRANSPORTATION SYSTEMS

Alexander Cohen Jan. 1967 24 p refs
(RR-6)

The annoyance problem caused by the radiation of transportation system noises into nearby inhabited areas is acknowledged, and schemes for controlling such noises are discussed. Site selection for transportation facilities emphasizing compatible land use in bordering areas, erection of barriers, use of cuts, and design changes and acoustical treatment of certain kinds of transportation installations are shown to be effective noise abatement measures. Author

N68-14205*# Avco Corp., Wilmington, Mass. Space Systems Div.

STUDY OF FERROMAGNETIC LIQUID

Ronald E. Rosensweig and Robert Kaiser Mar. 1967 238 p
(Contract NASw-1219)
(NASA-CR-91684) CFSTI: HC $3.00/MF $0.65 CSCL 20C

This work describes studies in the synthesis and modification of stable colloidal dispersions with strong magnetic response and Newtonian viscosity. It proves possible to produce a magnetic fluid that is characterized by a saturation magnetization greater than 700 gauss concomitant with a viscosity that is less than 30 centistokes. Determination is made of magnetization versus applied field, viscosity at various temperatures and fluid compositions, particle size and size distribution, surface tension, and other physical parameters. The experimental data are inter-correlated and yield estimates of various physicochemical parameters. Modification by reversible flocculation–peptization and other means yields ferromagnetic fluids with accented properties. An instability phenomenon is encountered when a uniform magnetic field is applied normal to the surface of the more highly magnetic fluids. A linearized perturbation analysis satisfactorily predicts critical parameters characterizing the transition of the smooth fluid surface to a new equilibrium state in which the surface possesses small scale deflections having a definite periodicity. Author

N68-14250# Stanford Univ., Calif. Stanford Linear Accelerator Center.

INVESTIGATION INTO THE EFFECTS OF CURRENT PULSE SHORTENING IN MULTISECTION LINEAR ACCELERATORS

A. I. Zykov, I. A. Grishaev, V. A. Vishnyakov, N. I. Mochesknikov, and G. D. Kramskoy [1967] 10 p refs Transl. into ENGLISH from Russian Rept.-276/VE-062
(SLAC-TRANS-73; Rept.-276/VE-062) CFSTI: HC $3.00/MF $0.65

The current pulse-shortening phenomenon is linear accelerators at 300 MeV and 2 GeV was studied, and the findings are presented. The character of the destruction of the beam, the amplitude and frequency of oscillations generated by the beam, the change of the amplitude of the hybrid wave upon the displacement of the axis of the accelerating system, and the dependence of the maximum value of the current at which the beam destruction effect is observed on the length of the accelerator are investigated. NSA

N68-14260# Atomics International, Canoga Park, Calif.
OPTIC 2: A SPHERICAL OPTICAL MODEL CODE
C. L. Dunford 21 Sep. 1967 13 p refs
(NAA-SR-Memo-12531) CFSTI: HC $3.00/MF $0.65

A spherical optical model is widely used in the analysis of scattering of light and intermediate-weight nuclides. Several computer codes are available, each with several advantages and disadvantages when compared with another code. The OPTIC code was chosen because it included, among other things, an R-matrix theory addition to the optical model. This code was converted from Fortran II to Fortran H, and several new features were added to compensate for known deficiencies. Author (NSA)

N68-14295 Imperial Coll. of Science and Technology, London (England). Dept. of Physics.
OPTICAL SOURCES OF DISTORTION IN BUBBLE CHAMBER PHOTOGRAPHY
W. T. Welford *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 13 p refs (See N68-14281 05-24)

Asymmetry of the lense or window surface figure, and inhomogeneity of the refractive index cause distortions in bubble chamber photographic tracking of particle trajectories. Errors in mounting and centering of individual optical components produce to a first approximation an effective prism in the lens aperture, which distorts straight lines into curves by the usual prismatic spectrum line curvature effect. Temperature changes effect mainly focus and scale of the image and cause ray deviations. Stress birefringence in glass can produce image doubling, especially in tempered windows. A final possible cause of asymmetry is the Faraday effect rotation due to the magnetic field effect; this applies especially in fields of 50 kilogauss and for wide angle lenses involving large angles of incidence. G.G.

N68-14297 Minnesota Univ., Minneapolis. Inst. of Technology.
GEOMETRICAL THEORY OF SCOTCHLITE
H. Courant *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 14 p ref (See N68-14281 05-24)

Ray tracing methods are used to analyse the reflective characteristics of Scotchlite reflective sheeting. This sheeting consist of small beads of transparent material having a high refractive index; the beads are coated on one hemisphere with a metallic layer and are attached on their coated side to the backing sheet. Rays striking the bead near its north pole will be reflected in the region of its south pole and emerge in a reflection angle. Thus, large fractions of the reflected light are reflected back towards the vicinity of the light source and make it possible to observe bubbles in liquid gases as dark objects against a bright background. Ray tracing through the successive processes of refraction–reflection and refraction upon entering, traversing, and leaving a sphere until a resonance angle is reached and until the angle decreases again establishes the maximum attainable scattering angle. Calculations for Scotchlite beads with a relative index of 1.70 show that about 90% of the reflected light is returned within a cone of about 9° half angle. G.G.

N68-14300 Ecole Polytechnique, Paris (France).
THE LARGE HEAVY LIQUID BUBBLE CHAMBER "GARGAMELLE": THE OPTICS
P. Petiau *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 17 p (See N68-14281 05-24)

The optical system described was designed to take particle track pictures in a large heavy liquid bubble chamber through two horizontal rows of four identical optics located on one side of the chamber. The system encompasses a fisheye-window covering a 110° total angular field, an objective, field lenses, and the image transport. This system provides a 68 mm-diameter telecentric image on 70 mmfilm; distortion is less than 1% and can be reduced by adjusting the nominal magnification and focal length. G.G.

N68-14302 Imperial Coll. of Science and Technology, London (England). Dept. of Physics.
DEVELOPMENT OF WIDE-ANGLE LENSES FOR THE ARGONNE 12 FT. BUBBLE CHAMBER
W. T. Welford *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 12 p (See N68-14281 05-24)

Initial design studies for wide angle lens photography in 12 feet bubble chamber of vertical cylinder shape established the following requirements; (1) wide field angle for large volume observation; (2) telecentricity for rapid cycling mode; (3) small diameter front elements to permit a ring source for Scotchlite illumination; (4) diffraction-limited correction of aberrations to permit the use of a high-resolving power film; and (5) a rather small overall length to have the camera set in vertical wells through the magnet iron. Concentric chamber windows were chosen because they eliminated reflections from the ring light source in the four lenses spaced in a circle at the top of the chamber. G.G.

N68-14303 European Organization for Nuclear Research, Geneva (Switzerland).
OPTICS OF THE LARGE-EUROPEAN HYDROGEN BUBBLE CHAMBER
H. P. Reinhard *In its* Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 8 p (See N68-14281 05-24)

Bare bead Scotchlite was tested for its vibration resistance and the formation of parasitic bubbles on its surface during low pressures. Vibration cycling tests from warm to cold, and impact load tests in a liquid nitrogen dewar did not losen any beads from the mylar membrane; the low pressure boiling test was also negative. Main requirements for the mounting of the concentric windows was precision within 0.1 to 0.2 mm, absolute tightness, and good resistance against thermal shocks. Thus, fused silica evolved as the material for the vacuum tank window, sealing was done by metallic O-rings, and the centering by clamping rings. G.G.

N68-14304*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
LECTURES ON GRAVITATION AND RELATIVITY, VOLUME 2
[1968] 278 p refs Seminar held at NASA. Goddard Inst. for Space Studies
(NASA-TM-X-60784) CFSTI: HC $3.00/MF $0.65 CSCL 20J

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3. THE DEGENERATE STAR, A RELATIVISTIC CATASTROPHE J. A. Wheeler (Princeton Univ.) 37 p (See N68-14307 05-30)

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5. POSSIBLE EFFECTS ON THE SOLAR SYSTEM OF WAVES R. H. Dicke (Princeton Univ.) 34 p (See N68-14309 05-30)

6. THE LYTTLETON-BONDI UNIVERSE AND CHARGE EQUALITY V. W. Hughes (Yale Univ.) 41 p refs (See N68-14310 05-24)

7. QUANTIZATION OF GENERAL RELATIVITY J. L. Anderson (Stevens Inst. of Tech.) 45 p refs (See N68-14311 05-23)

8. MACH'S PRINCIPLE AS BOUNDARY CONDITION FOR EINSTEIN'S FIELD EQUATIONS J. A. Wheeler (Princeton Univ.) 86 p refs (See N68-14312 05-23)

N68-14306*# Stevens Inst. of Tech., Hoboken, N. J.
RELATIVITY PRINCIPLES AND THE ROLE OF COORDINATES IN PHYSICS
J. L. Anderson *In* NASA. Goddard Inst. for Space Studies Lectures on Gravitation and Relativity, Vol. 2 [1966] 41 p refs (See N68-14304 05-23)

The conservation laws associated with general relativity are considered. The relations between the invariance properties and conservation laws are discussed, and it is shown that the principle of general relativity is intimately related to the coordination of the underlying space-time manifold. C.T.C.

N68-14308*# Maryland Univ., College Park.
GRAVITATION AND LIGHT
Joseph Weber *In* NASA. Goddard Inst. for Space Studies Lectures on Gravitation and Relativity, Vol. 2 [1966] 19 p refs (See N68-14304 05-23)

A discussion is presented of gravitation and light in the following areas: (1) gravitational deflection of light by a nonrelativistic method, (2) relativistic results, (3) effect of the photon spin, (4) the gravitational red shift, (5) comparison of the theories of Maxwell and Einstein, (6) electrodynamics in arbitrary coordinates and its geometrization, and (7) quantization of the coupled Maxwell Einstein fields. C.T.C.

N68-14311*# Stevens Inst. of Tech., Hoboken, N. J.
QUANTIZATION OF GENERAL RELATIVITY
J. L. Anderson *In* NASA. Goddard Inst. for Space Studies Lectures on Gravitation and Relativity, Vol. 2 [1966] 45 p refs (See N68-14304 05-23)

Consideration is given to the Hamiltonian formulation of general relativity. Emphasis is placed on the difficulties to be encountered in quantizing general relativity, and the motives, advantages, and disadvantages are pointed out. Various examples are shown, and all appear to contain incompatibilities between the requirements of quantum mechanics and the requirements of general relativity. C.T.C.

N68-14312*# Princeton Univ., N. J.
MACH'S PRINCIPLE AS BOUNDARY CONDITION FOR EINSTEIN'S FIELD EQUATIONS
J. A. Wheeler *In* NASA. Goddard Inst. for Space Studies Lectures on Gravitation and Relativity, Vol. 2 [1966] 86 p refs (See N68-14304 05-23)

A formulation of Mach's Principle is discussed. 3-geometry and its rate of change as keys to the plan of general relativity are examined, and comments are made on Mach's Principle and the intrasurface variational principle. Rigorous justifications are given for the inclusion of this principle as a part of relativity, and its shortcomings and the mathematical questions it raises are pointed out. It is proposed that Mach's Principle be viewed as the boundary condition for Einstein's field equations, and an essential part of the plan of general relativity. The condensed intrasurface variational principle is the most compact mathematical statement available of this interpretation of Mach's Principle. As conceived here, it carries with it the tacit requirement that the model universe be closed. C.T.C.

N68-14345* Bell and Howell Research Center, Pasadena, Calif.
A STUDY OF THE INTRODUCTION OF IONS INTO THE REGION OF STRONG FIELDS WITHIN A QUADRUPOLE MASS SPECTROMETER Final Report, 17 Aug. 1965–17 Oct. 1967
Wilson M. Brubaker 17 Oct. 1967 187 p refs
(Contract NASw-1298)
(NASA-CR-91801) CFSTI: $3.00 CSCL 20F

Theoretical and experimental studies were made of the introduction of ions into the strong fields of a quadrupole mass filter, and of the advantages of hyperbolic instead of round field-forming surfaces. Computer studies have shown that the ion receives a large impulse in the y-direction. Through the use of an additional set of four electrodes in the vicinity of the entrance to the mass filter, it is possible to cause the working point to remain within the stable portion of the stability diagram as the ion traverses the fringing fields. This is accomplished by lessening the ratio of the dc to the ac potentials applied to the auxiliary electrodes. This increases the sensitivity of the quadrupole by factors of ten to one-hundred at no sacrifice in resolving power under favorable conditions. The perturbations in the electric fields which result from the use of round instead of hyperbolic rods have been evaluated with the help of a computer. Comparative experiments show a distinct advantage of the quadrupole with hyperbolic field-forming surfaces over a similar quadrupole with round field-forming surfaces. At comparable sensitivities, the resolving power of a hyperbolic rod system is about twice that of a round rod system. Author

N68-14374 United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
AN ELEMENTARY ACCOUNT OF THE THEORY OF IMAGE CONTRAST IN ELECTRON MICROSCOPES
M. J. Makin Sep. 1967 54 p
(AERE-R-5571) HMSO: 7s

An elemetary and straightforward account is given of both the kinematical and dynamical theories of diffraction contrast, including the treatment of multiple beams. Throughout, the mathematical derivations are given in considerable detail so that readers with little mathematical knowledge can follow and understand how the final expressions are obtained. An appendix containing all the mathematics required (including the use of matrices) is attached. Author

N68-14437# New Mexico Univ., Albuquerque. Dept. of Physics and Astronomy.
OPTICAL BACKSCATTERING FROM SINGLE WATER DROPLETS

T. S. Fahlen and H. C. Bryant Sep. 1967 35 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.
(Contract AT(29-1)-789)
(SC-CR-67-2724) CFSTI: HC $3.00/MF $0.65

A study was made of the two mechanisms responsible for the backscattering of light by water droplets: the axial ray and the edge ray. Using a He–Ne laser and a fiber-supported water droplet, ranging in diam from .6 to 1.5 mm, observations were made of the intensity fluctuations of these two rays as the droplet evaporated. The axial ray varied sinusoidally with droplet size parameter, and the edge ray varies in a very complicated, but periodic manner. The edge ray signal, as a function of the size parameter, appears to consist of periodic "humps" of spacing $.27 \pm .01$, upon which are superimposed, in a coherent manner, clusters of "spikes", very narrow resonances. The basic spike period seems to be $.82 \pm .02$. A complicated beating phenomenon appears to be present with a period of 60.7 ± 1.5. A comparison of the experimental results is made with the results of a Mie computation at 3000 in the size parameter and with a simple model. Author (NSA)

N68-14447# Virginia Univ., Charlottesville. Dept. of Physics.
PROCEEDINGS OF THE SYMPOSIUM ON THE PHYSICS OF SUPERCONDUCTING DEVICES
Aug. 1967 232 p refs Symp. held in Charlottesville, Va., 28–29 Apr. 1967
(Grant Nonr(G)-00015-67)
(AD-661848)

Lectures presented at a symposium on the physics of superconducting devices deal with accelerators, magnetometers, gravimeters, the Josephson junctions, current transformers, amplification and interference devices, and measurement techniques. For individual titles see N68-14447 to N68-14469.

N68-14448# Stanford Univ., Calif.
A SUPERCONDUCTING LINEAR ACCELERATOR AND THE USE OF SUPERCONDUCTIVITY IN SOME FUNDAMENTAL EXPERIMENTS IN PHYSICS
William M. Fairbank *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 20 p refs Sponsored by NASA and AF (See N68-14447 05-23)

Superconductivity coupled with a low temperature environment is considered to be of promise for improving linear accelerators, checking the general theory of relativity, performing a time reversal invariance experiment with great accuracy, serving as a gravity meter to search for quarks, and numerous other experimental efforts. Linear accelerators are discussed in general, and the use of superconductivity and superfluidity to improve their capabilities is noted. A schematic for a cryogenic system for a superconducting accelerator is presented, along with a schematic of a recirculating linac using superconducting bending magnets. Schiff calculations and Dickey effect, London readout equipment, and numerous related experimental setups are included. M.W.R.

N68-14450# Stanford Univ., Calif. High Energy Physics Lab.
THE APPLICATION OF SUPERCONDUCTORS IN THE CONSTRUCTION OF HIGH-Q MICROWAVE CAVITIES
Michael S. McAshan *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 8 p refs (See N68-14447 05-23)
(Contract Nonr-225(67))

Microwave properties of superconducting surfaces are being investigated, and possible applications of single superconducting microwave cavities are presented. Experimental surface data are shown for lead at 11.2GHz, along with best fits according to Mattis and Bardeen theory for both lead and tin. Breakdown fields are plotted against temperature for tin. M.W.R.

N68-14462# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE ATTAINMENT OF ZERO MAGNETIC FIELD IN A SUPERCONDUCTING LEAD SHELL
Alvin F. Hilderbrandt (Houston Univ.) and D. D. Elleman *In* Va. Univ. Proc. of the Symp. of the Phys. of Superconducting Devices Aug. 1967 6 p refs (See N68-14447 05-23)
(Contract NAS7-100)

Various experimental studies are summarized that illustrate the attainment of zero magnetic field in a superconducting lead shell. Static magnetic fields of less than 2×10^{-6} gauss were realized by using the Meissner effect in a superconducting lead shell in a room size μ-metal shield, and the ambient field inside the μ-metal shield was less than 100 microgauss as long as the surrounding laboratory temperature was fairly constant. Results of six experiments of a lead shell in a reduced field are summarized. Trapped axial fields as large as 5 milligauss are attributed to a dc effect that does not disappear. When the switch is activated the field in the hollow of the tube does not decay but can be varied by applying an external force. This indicates a large current is flowing even though the warmed region is normal, and the effect is believed due to strain and temperature gradients. M.W.R.

N68-14466# Stanford Univ., Calif.
DEVICE APPLICATION OF SUPER-INDUCTORS
William A. Little *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 17 p (See N68-14447 05-23)

Plasmons and quasi-particles are discussed in relation to device applications of superinductors. Plots of the excitation spectrum of the electron gas are shown, and an attempt is made to picture the real situation for the plasmons for a sample of finite size. Close to the origin are found additional modes, the antenna modes, which in the case of dipoles will have a slope given by the velocity of light. There will also be quasi-particle excitations. In a superconductor the continuum is lifted up somewhat so that the quasi-particle excitations degenerate with some of the plasmons. The inertial properties of the two interpenetrating electron fluids that exist in a superconductor are considered, along with the magnetic field contributions. Kinetic inductance of superelectrons is discussed, and the possibility of large industances and extremely high gain in small spaces is noted for parametric amplification. M.W.R.

N68-14467# General Electric Co., Schenectady, N. Y. Research and Development Center.
FLUXFLOW AND DIRECT CURRENT TRANSFORMERS
Ivar Giaever *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 1 p refs (See N68-14447 05-23)

Because the relative motion between quantized vortices or fluxons and the lattice causes a voltage to appear along a type II superconductor in a high magnetic field, these devices can be resistive and still remain in a superconductive state. By using this fluxflow to advantage, it is possible to construct dc transformers, controllable rectifiers, and fluxpumps. M.W.R.

N68-14558# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
THE EFFECT OF ATMOSPHERIC NONUNIFORMITY ON SONIC BOOM INTENSITIES

Ryuma Kawamura and Mitsuo Makino Oct. 1967 36 p refs *Its* Vol. 32, No. 9
(ISAS-416)

The effect of atmospheric non-uniformity on the decay of shock waves generated by a supersonic aircraft in steady level flight with special reference to sonic boom problem is presented. At the outset, analysis is made for an axisymmetric body in an adiabatic atmosphere, together with two-dimensional body case for the sake of reference. The decay rule of a bow shock due to atmospheric nonuniformity is obtained by the application of Whitham's theory on the behavior of shock waves at large distances from the body in a uniform medium to the case of a stratified atmosphere. Numerical calculations are carried out at flight Mach numbers from 1.3 to 3.0 and flight altitudes up to 10 km. Extension of the above-mentioned technique makes it possible to obtain the decay of a bow shock in an arbitrary stratified atmosphere and a numerical calculation is made for the case of an axisymmetric body in a standard atmosphere at the same flight Mach numbers as above and flight altitudes up to 20 km. The result shows good agreement with existing flight test-data and other theoretical result by different method. Author

N68-14627# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
QUADRUPOLE CORRELATIONS GOVERNING THE PATTERN OF JET NOISE
Herbert S. Ribner Nov. 1967 42 p refs
(Grant AF-AFOSR-672-67)
(UTIAS-128; AFOSR-67-2159; AD-662012)

The effects of convection and refraction dominate the heart-shaped pattern of jet noise. These can be corrected out to yield the basic directivity of the eddy noise generators. The observed quasi-ellipsoidal pattern was predicted by Ribner (1963, 1964) in a variant of the Lighthill theory, postulating isotropic turbulence superposed on a mean shear flow. This had the feature of dealing with the joint effects of the quadrupoles without displaying them individually. The paper reformulates the theory so as to calculate the relative contributions of the different quadrupole self- and cross-correlations to the sound emitted in a given direction. Spectra are also discussed, following the earlier work. Finally, the predictions are shown to be compatible with recent experimental results. Of the 36 possible quadrupole correlations only 9 yield distinct nonzero contributions to the axisymmetric noise pattern of a round jet. The individual directional patterns have either 2 or 4 lobes, but they combine to yield a quasi-ellipsoidal overall pattern (basic directivity before convection or refraction are allowed for). This is compounded of partial patterns called self-noise and shear-noise. Author (TAB)

N68-14668# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
STANDARD PROGRAM FOR MAGNETIC FIELD CALCULATION IN THE TRACK POINTS USING A PRESET THREE-DIMENSIONAL TABLE FOR THE CHAMBER MAGNETIC FIELD [STANDARTNAYA PROGRAMMA DLYA VYCHISLENIYA MAGNITNOGO POLYA V TOCHKAKH TREKA PO ZADANNOI TREKHMERNOI TABLITSE MAGNITNOGO POLYA V KAMERE]
V. I. Moroz, O. V. Mukhitova, and G. N. Tentyukova 1967 19 p In RUSSIAN
(JINR-P11-3512)

This program is meant for calculation (by the linear interpolation method) of vectors of the magnetic field strength $H_x(x,y,z)$, $H_y(x,y,z)$, $H_z(x,y,z)$ for the set of space points in cases when the magnetic field is set in the points of three-dimensional orthogonal lattice. Author (NSA)

N68-14683# Los Alamos Scientific Lab., N. Mex.
METHOD FOR CORRECTING KNUDSEN VAPOR PRESSURES FOR CELL-VAPOR INTERACTIONS
John W. Ward [1967] 15 p refs Presented at the 3d Intern. Symp. on High Temp. Technol., Pacific Grove, Calif.
(Contract W-7405-ENG-36)
(LA-DC-8786; CONF-670935-6) CFSTI: HC $3.00/MF $0.65

A formula was derived, which allows correction of Knudsen vapor pressures for cell losses if the effusate distribution and the condensation coefficient are known. Computer and experimental studies support the validity of the formula. It is emphasized that the treatment is valid only for collimator–target experiments in which the flux from only the sample surface is analyzed. Author (NSA)

N68-14707# Max-Planck-Institut fur Chemie, Mainz (West Germany).
A NUCLEAR RESONANCE SYSTEM FOR MEASUREMENT AND STABILIZATION OF MAGNETIC FIELDS BETWEEN 0.1 AND 20 KG [EINE KERNRESONANZANORDNUNG ZUR MESSUNG UND STABILISIERUNG VON MAGNETFELDERN ZWISCHEN 0,1 G UND 20 KG]
J. R. Tatarczuk Jan. 1967 18 p refs In GERMAN; ENGLISH summary
(BMWF-FBK-67-03)

A nuclear resonance system can be built which uses the same principal components as an atomic beam resonance apparatus whereby the atomic beam has been replaced by a flow of a liquid. The technique can be used for the measurement of stabilization of magnetic fields. Since the three fields for the polarization, measurement and detection of polarization are separated from each other the accuracy of the system is constant within a range from 0.1 G to 20 kG. Such a system is described and its properties and limitations are discussed. Author (NSA)

N68-14713# Brookhaven National Lab., Upton, N. Y.
FIELD STABILIZATION IN PERIODIC SYSTEMS
D. Carter 21 Sep. 1967 9 p refs
(BNL-11841) CFSTI: HC $3.00/MF $0.65

Stabilization of periodic fields for any periodic system is described together with a measure of such stabilization. Dispersion relations and fields are expressed for stabilized cavities. Author (NSA)

N68-14749# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
AN ANALYSIS OF ERRORS INVOLVED IN THE SUB-PROMPT CRITICAL TRANSIENT EXPERIMENTS IN SEFOR
B. A. Hutchins and K. Ott Feb. 1967 37 p refs
(KFK-578)

Subprompt critical transient experiments for SEFOR are discussed. A statistical error approach is used to calculate minimum permissible transients and analyze Doppler coefficient measurements. A determination of the sensitivity of the error in the Doppler coefficient due to the size of the impressed transient is made. The Doppler effect is assumed to dominate the prompt reactivity feedback. NSA

N68-14822# Commissariat a l'Energie Atomique, Saclay (France).
THEORY, ANALYSIS AND APPLICATIONS OF THE FUNCTION OF THE SUPERCONDUCTOR TRANSFORMER FEEDING IN CONTINUOUS CURRENT, A CIRCUIT OF NONDISSIPATIVE SUPERCONDUCTOR CHARGE [THEORIE, ANALYSE ET APPLICATIONS DU FONCTIONNEMENT DU TRANSFORMATEUR SUPRACONDUCTEUR ALIMENTANT EN COURANT CONTINU UN CIRCUIT DE CHARGE SUPRACONDUCTEUR NON DISSIPATIF]
Jean Sole Jun. 1967 11 p refs In FRENCH
(CEA-R-3242)

Consideration is given to a concept of transformers with wound superconductors. Equations are derived for a functional analysis of the various modes of the slow, variable continuous current; magnetic circuit effects are taken into account. Some possible examples of industrial usage are given as illustrations. Transl. by M.G.J.

N68-14874# Los Alamos Scientific Lab., N. Mex.
PRESENT STATUS OF DIFFUSE REFLECTANCE THEORY
Harry G. Hecht [1967] 37 p refs Presented at the 154th Natl. Meeting of the Am. Chem. Soc., Chicago
(Contract W-7405-ENG-36)
(LA-DC-8805; CONF-670904-8) CFSTI: HC $3.00/MF $0.65

A review of progress in the theoretical interpretation of diffuse reflectance spectra is given. The Kubelka–Munk solution is discussed in terms of the more general theory of radiative transfer, and the layer and particle models of Johnson and Melamed are also considered. The nature of multiple scattering processes, reflectance of nonhomogeneous materials, and methods of chemical analysis are specialized topics that are discussed in some detail. Author (NSA)

N68-14898 California Univ., Livermore. Lawrence Radiation Lab.
CALCULATION OF THE DYNAMIC RESISTANCE OF MATERIAL [LE CALCUL DE LA RESISTANCE DYNAMIQUE D'UN MATERIAU]
Mark L. Wilkins 15 Sep. 1967 11 p refs In FRENCH Presented at High Dyn. Pressure, Paris, 11–15 Sep. 1967

A model to describe the dynamic behavior and resistance of a material is formulated that accounts for relaxation effects. The physical basis for the model is from the theory of dislocations, and a Lagrangian method is used to calculate both unidimensional and bidimensional flow of a nonpermanent nature. Transl. by M.W.R.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-13941# Argonne National Lab., Ill.
THE RESPONSE OF MONOENERGETIC GAMMA RAYS IN FINITE MEDIA
William J. Snow Apr. 1967 32 p refs
(Contract W-31-109-ENG-38)
(ANL-7314) CFSTI: HC $3.00/MF $0.65

The response parameters of monoenergetic gamma rays incident on various materials with finite geometries has been calculated on a CDC-3600 computer. The Monte Carlo technique was used to obtain the solution to this gamma-ray transport problem. The program permits calculations of various source geometries and detector shapes for incident gamma rays varying in energy from 5 keV to 12 MeV. Results are included for gamma rays normal to cylindrical germanium and silicon detectors. Also presented are the data representing the double and single escapes subsequent to positron annihilation occurring uniformly throughout the volume of the detector. Author (NSA)

N68-13952# Oak Ridge National Lab., Tenn.
NEUTRON PHYSICS DIVISION Annual Progress Report, Period Ending May 31, 1967
Aug. 1967 151 p refs
(Contract W-7405-ENG-26)
(ORNL-4134) CFSTI: HC $3.00/MF $0.65

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8. EXPERIMENTAL STUDIES FOR HIGH-ENERGY RADIATION SHIELDING p 129–148 refs (See N68-13960 05-24)

N68-13953# Oak Ridge National Lab., Tenn.
NUCLEAR AND REACTOR PHYSICS
In its Neutron Phys. Div. Aug. 1967 p 1–27 refs (See N68-13952 05-24)

Continuing research is briefly reported on analyses and measurements of data in conjunction with nuclear reactors. Among the topics covered are the following: neutron spectra, scattering, and cross sections; capture and fission relations; nuclear reactions; and proton scattering. N.E.N.

N68-13956# Oak Ridge National Lab., Tenn.
RADIATION SHIELDING INFORMATION CENTER
In its Neutron Phys. Div. Aug. 1967 p 83–88 refs (See N68-13952 05-24)

Recent developments in the center's operations are reviewed, and include descriptions of the nuclear data file, computer-based customer file, and improved record-keeping practices for the code collection. Summaries are also given of studies in dosimetry, shielding requirements, and calculation methods. N.E.N.

N68-13959# Oak Ridge National Lab., Tenn.
THEORETICAL STUDIES FOR HIGH-ENERGY RADIATION SHIELDING
In its Neutron Phys. Div. Aug. 1967 p 112–128 refs (See N68-13952 05-24)

Theoretical studies on elementary particle radiations are presented. The topics cover energy spectra, particle production,

particle interactions and collisions, radiation effects and hazards, particle transport, and related calculation procedures. N.E.N.

N68-13960# Oak Ridge National Lab., Tenn.
EXPERIMENTAL STUDIES FOR HIGH-ENERGY RADIATION SHIELDING
In its Neutron Phys. Div. Aug. 1967 p 129–148 refs (See N68-13952 05-24)

Experimental studies on high energy particle interactions are reviewed. Emphasis is placed on proton irradiation and particle production. Mass and energy spectra and programs for calculations are also covered. N.E.N.

N68-13971# Brookhaven National Lab., Upton, N. Y.
LOOKING AT MATTER WITH PARTICLES
Harry Palevsky 24 May 1967 13 p *Its* Lecture Ser. No. 66
(BNL-50059(T-462)) CFSTI: HC $3.00/MF $0.65

The lecture is begun with a few remarks on measurement methods in physics. X-ray diffraction is discussed briefly, and the use of slow neutrons to study the nucleus, atomic magnetism, and thermal lattice vibrations is considered in detail. The cold neutron facility of the Brookhaven Graphite Reactor is described. Some results are given from investigations of various aspects of the dynamics of solids and liquids, covering Al, V, water vapor, NH_4Br, azoxyanisole, and He II (rotons). Van Hove's theory of neutron scattering from liquids is considered in detail. Finally, the work at the Cosmotron on the use of high-energy protons to study the nucleus is described briefly. NSA

N68-13979 Tokyo Univ. (Japan). Dept. of Physics.
LEPTONIC DECAY OF THE PION AND THE SPECTRAL FUNCTION SUM RULES
Syurei Iwao Oct. 1967 5 p refs

Leptonic decay of the pion is investigated under spectral function sum rules, and the axial vector meson is included to clarify the dynamical nature of the problem. An analysis that begins with the Lagrangian density indicates that the pion mass should be included in the denominator of the pole term in the spectral representation, and that the numerical result obtained is consistent with the positive definiteness of the spectral function in the pole term and in the continuum region. The discrepancy between the Goldberger–Treiman relation and the experimental value is due to the odd number of pion effect in the continuum region, and this can be explicitly separated in the spectral representation. M.W.R.

N68-13990 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
A POSSIBLE EXPLANATION OF THE Λ TO Σ RATIO IN THE ISOSPIN 1 S-WAVE $\bar{K}$-N REACTION IN A QUARK MODEL DESCRIPTION
F. M. Renard Nov. 1967 9 p refs
(TH-226)

A proposal is given for explaining the discrepancy between the calculation of the parameter ϵ in the quark model and its experimental value. In addition to the single quark amplitude we consider a diquark amplitude of the backwards-scattering-type; its value is determined independently from $K^- + p \rightarrow \Sigma + \pi$ cross sections; the prediction for ϵ agrees then with experiment, but is very sensitive to low energy $\bar{K} + p$ parameters. Author

N68-14010# National Reactor Testing Station, Idaho Falls, Idaho.
GRIPE 2, A COMPUTER PROGRAM FOR THE ANALYSIS OF DATA FROM A PULSED-NEUTRON EXPERIMENT
N. C. Kaufman Sep. 1967 72 p refs
(Contract AT(10-1)-1230)
(IN-1085) CFSTI: HC $3.00/MF $0.65

GRIPE II, written in FORTRAN IV for use on the IBM-7040 computer, is a program for the analysis of experimental data taken in pulsed-neutron experiments. It may be used for experiments in either a critical or subcritical reactor and also for data with one or two exponential decays. The program features a complete error analysis including the significant but often neglected covariance terms, X–Y plots of the data with computed curves included, and routines to detect and reduce the influence of any bias in the experimental data. A value for the reactivity of a subcritical system is calculated using both the extrapolated-area-ratio method and the Garelis–Russell method. This program is operational, a typical processing time on the IBM-7040 being 1.1 minutes for each pulsed-neutron experiment. Author (NSA)

N68-14027# California Univ., La Jolla.
MAGNITUDE AND SIGN OF THE K_1^0–K_2^0 MASS DIFFERENCE
Susarla Suryanarayana Murty (Ph.D. Thesis) 1967 140 p refs
(Contract AT(11-1)-GEN-10)
(UCSD-10P10-103) CFSTI: HC $3.00/MF $0.65

The magnitude and sign of the mass difference $\delta = M_{K_2^0} - M_{K_1^0}$, where K_1^0 and K_2^0 are superpositions of the neutral K^0 and $\bar{K}^0$ mesons, are studied. The method used to investigate this consists in producing a K^0 beam, by charge exchange of a K^+ beam, at time zero. The K^0 beam, after a certain time, passes through a stainless steel regenerator. At the exit of the regenerator, the beam contains the originally produced but attenuated K_1^0 beam and a K_2^0 regenerated K_1^0 beam. The phase of these two waves depends on the distance from the source to the generator, multiplied by the mass difference, δ. The interference effects of the common decay mode ($\pi^+\pi^-$) were studied, by varying the distance between the source and the regenerator, and have obtained the following results: proof that the two waves decay into quantum mechanically identical states; the magnitude of the mass difference is $+0.46 \pm 0.02$, and K_2^0 is heavier than K_1^0. Author

N68-14041# Los Alamos Scientific Lab., N. Mex.
SYNTHESIS OF NEUTRON-RICH NUCLIDES
George A. Cowan Jul. 1967 8 p refs Presented at the 153d Natl. Meeting, Am. Chem. Soc., Miami Beach, Fla., 11–14 Apr. 1967
(Contract W-7405-ENG-36)
(LA-3736; CONF-670401-13) CFSTI: HC $3.00/MF $0.65

The technique of multiple neutron capture in nuclear explosives is compared with alternative methods for the production of heavy elements. Some recent data from the "Cyclamen" experiment are cited to summarize the present state-of-the-art and prospects for further progress are reviewed. Author (NSA)

N68-14044# California Univ., Berkeley. Lawrence Radiation Lab.
OPTICAL PUMPING IN ATOMIC LEAD
Berken Chang (Ph.D. Thesis) 28 Aug. 1967 108 p refs
(Contract W-7405-ENG-48)
(UCRL-17765) CFSTI: HC $3.00/MF $0.65

The optical orientation of the nucleus in the $6s^26p^2\ ^3P_0$ ground state of ^{207}Pb was attempted. Light sources with differing ratios of hyperfine intensities are evaluated to determine their contribution. These sources, in particular a pressure-shifted-hyperfine-absorption filter and a self-reversed ^{208}Pb lamp, were studied spectroscopically and were then used for pumping. Optical pumping rate equations were used to estimate the

signal to noise as a function of R, the ratio of the hyperfine intensities and k, the mixing parameter. Radioisotope lead lamps were also developed for use in future pumping of ^{203}Pb or ^{205}Pb. A detection system was developed which has sufficient sensitivity to detect a signal when the relaxation time is greater than 10 msec. No signal is seen in cells without a buffer gas, with 10 torr of He buffer, and with 100 torr He buffer. The shortness of the relaxation time deduced for an unbuffered cell is partially explained by the length of the cell wall adsorption time of a lead atom. The shortness of the relaxation time when using a helium buffer is surprising and suggests that the ground state of Pb may not be spherically symmetrical on buffer gas collisions. Author (NSA)

N68-14049# California Univ., Berkeley. Lawrence Radiation Lab.
VERSATILE APPARATUS FOR MEASURING TOTAL AND DIFFERENTIAL CROSS SECTIONS FOR ION-NEUTRAL INTERACTIONS
W. R. Gentry Jul. 1967 106 p refs
(Contract W-7405-ENG-48)
(UCRL-17691) CFSTI: HC $3.00/MF $0.65

A beam apparatus for studying the dynamics of ion-neutral interactions in the primary ion energy range 5 to 500 eV is described. The criteria considered in the design of the apparatus are discussed, and a description of the individual components and their interrelation is given. Discussion of the experimental operation and data analysis is included. The two modes of operation by which data were previously obtained are used to illustrate the capabilities of the equipment. NSA

N68-14053# Henry Ford Hospital, Detroit, Mich. Edsel B. Ford Inst. for Medical Research.
A COMPILATION OF BETA EXCITED X-RAY SPECTRA. PART 2: (^{90}Sr-^{90}Y, ^{63}Ni, ^{204}Tl)
Luther E. Preuss, C. Artman, C. Bugenis, and H. Collins Oct. 1967 226 p
(Contract AT(11-1)-1239)
(TID-22361, Pt. 2) CFSTI: HC $3.00/MF $0.65

The X-ray spectra resulting from the exposure of a number of elements to the beta particles from ^{63}Ni, ^{90}Sr–^{90}Y, and ^{204}Tl are presented. The spectra were measured using proportional and scintillation counters. The experimental conditions are given with each spectrum. NSA

N68-14060# California Univ., Livermore. Lawrence Radiation Lab.
DETERMINATION OF OXYGEN DIFFUSION IN CERAMICS BY MEANS OF NUCLEAR ACTIVATION
Ralph H. Condit and J. Birch Holt 2 Oct. 1967 12 p refs Presented at the Joint Meeting of the Ger. Phys., Glass Ind., and Ceram. Soc., Erlangen, Ger., 19–20 Oct. 1967
(Contract W-7405-ENG-48)
(UCRL-70580; CONF-671016-1) CFSTI: HC $3.00/MF $0.65

A technique which makes it possible to use the rare isotopes of oxygen, ^{17}O and ^{18}O, as if they were radioactive tracers was developed for studying oxygen transport. For this purpose, a little of the concentrated isotope is incorporated at selected points within a ceramic specimen, the sintering or reaction experiment is carried out, and the isotope is then converted to the radioactive species ^{18}F by nuclear activation bombardment with 1-MeV deuterons or 2.8-MeV protons. The consequence of this is that ^{17}O or ^{18}O may be used as if they were radioactive tracers, the important difference being that they remain non-active until after an experiment and only then are they converted to a radioactive form. The principal purpose for using this approach is to make possible the use of autoradiographic film techniques which can serve to precisely locate the oxygen tracer and measure its concentration. The application of this technique to several studies in ceramics is discussed. NSA

N68-14061# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
A WAVE-MECHANICAL CALCULATION OF THE SCATTERING OF NEUTRONS BY MAGNETISED CRYSTALS
W. Doering Sep. 1967 20 p refs Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), v. 20, no. 5, 1966 p 311–317
(AERE-TRANS-1075)

The scattering of neutrons by magnetised crystals is calculated on the assumption that the induction in the scatterer is a given function of time and position. This assumption, which is not really valid for inelastic scattering, causes only a slightly incorrect factor in the absolute value of the intensity in scattering with emission of magnons. The error is of no practical importance, and the advantage is that the calculation can be made without any assumptions regarding the Hamiltonian operator of the magnetised substance. The time average induction determines the elastic scattering; the oscillations of magnetisation cause inelastic scattering. The formulae for the intensity and polarisation of the scattered neutrons as functions of the directions of magnetisation and polarisation of the incident neutrons, previously derived only for the Heisenberg model, are re-derived in a simpler manner. It is shown that the observed dependence on the direction of polarisation is not a function of the interaction between magnetic moments, but is governed only by the precession of the electron spins and the direction of their rotation. The calculations are generalised to the case where the precession describes a cone of elliptical cross-section. Author

N68-14073 United Kingdom Atomic Energy Authority, Harwell (England). Theoretical Physics Div.
SCAT AND SLAB: TWO COMPUTER CODES FOR THE COMPUTATION OF THERMAL NEUTRON SCATTERING CROSS-SECTIONS
P. Hutchinson and P. Scholfield Sep. 1967 55 p refs
(AERE-R-5536) HMSO: 8s

This report describes the principles and method of operation of two computer codes, SCAT and SLAB for the computation of inelastic scattering cross-sections for thermal neutrons in the incoherent Gaussian approximation. SLAB computes the thermal neutron scattering law and SCAT the macroscopic energy change cross-sections, $\Sigma(E' \rightarrow E)$ in a suitable form for reactor calculations covering the energy range 0–10 eV, and over a more limited range, the linearly anisotropic component of the scattering $\Sigma_1(E' \rightarrow E)$. Both codes use a numerical Fourier transform method of evaluation which is both more flexible and more reliable than previous methods. Author

N68-14075 United Kingdom Atomic Energy Authority, Harwell (England). Research Reactors Div.
SUBROUTINE HEITLER
A. Foderaro Sep. 1967 24 p refs
(AERE-M-1956) HMSO: 3s 6d

Subroutine HEITLER computes the Compton, photoelectric, pair-production, and total microscopic cross-sections for any element in the range of atomic numbers from 1 to 94 inclusive, for any photon energy in the range 10 keV to 20 MeV inclusive. It also computes either the Compton absorption cross-section or the Klein–Nishina differential scattering cross-section, as desired. The Compton cross-sections are computed theoretically. The photoelectric and pair-production cross-sections are obtained by suitable interpolation in atomic number and energy using a compilation of 25 sets (more or less) of measured cross-sections. Author

N68-14095# Atomics International, Canoga Park, Calif.
CALCULATIONS OF Pu^{239} RESONANCE CROSS SECTIONS USING FISSION WIDTHS FROM CHANNEL FISSION THEORY
J. M. Otter
(Contract AT(04-3)-701)
(NAA-SR-12515) CFSTI: HC $3.00/MF $0.65

Multigroup cross sections for ^{239}Pu are calculated using standard single-level isolated line shapes, but with different average fission widths for each (I,J) series rather than equal ones, as has been common practice. The average fission widths and the degrees of freedom in the distributions were calculated from channel fission theory. Using the 1=1 strength function, the number of open channels for the (0,0) series, and the average fission width at E=0 for the (0,1) series as parameters, acceptable fits to experimental curves of σ_f and $\alpha=\sigma_c/\sigma_f$ were found in the 40-eV to 250-keV range. The Doppler effect for a typical fast critical assembly was calculated and was found to be less than 25% of that obtained in the equal fission width mode. The two fission widths could only be optimized as a set pending better measurements of α below 10 keV, and/or Doppler coefficients. Multilevel and overlap effects are discussed and are shown to be probably not serious problems for ^{239}Pu. Author (NSA)

N68-14114# Idaho Nuclear Corp., Idaho Falls.
FISSION PRODUCT TRANSIENT MEASUREMENTS IN THE ADVANCED REACTIVITY MEASUREMENT FACILITIES
R. G. Nisle, I. E. Stepan, D. A. Millsap, and E. Fast Sep. 1967 27 p refs
(Contract AT(10-1)-1230)
(IN-1096) CFSTI: HC $3.00/MF $0.65

The yields of ^{135}I in the fission of ^{233}U, ^{239}Pu, and ^{241}Pu relative to that for ^{235}U were measured by an integral method using the Advanced Reactivity Measurement Facilities (ARMF I and II). The xenon reactivity transient was measured following irradiation of the fissile isotope in the Materials Testing Reactor (MTR) for periods from 2.5 to 110 days. The use of the two ARMF reactors permits the calculation of the absorption cross sections of both simple absorbers and fissile atoms. Calibration and data reduction techniques make extensive use of digital computer codes and take account of nonlinear reactivity responses of the reactors. The ^{135}I yield ratios, relative to ^{235}U, were found to be 0.825 ± 0.072 for ^{233}U, 1.006 ± 0.087 for ^{239}Pu, and 1.221 ± 0.089 for ^{241}Pu. The quoted uncertainties are confidence intervals at the 90% confidence level. Author (NSA)

N68-14116# Atomic Energy Commission, New York. Health and Safety Lab.
LEGENDRE, TSCHEBYSCHEFF, AND HALF-RANGE LEGENDRE POLYNOMIAL SOLUTIONS OF THE GAMMA RAY TRANSPORT EQUATION IN INFINITE HOMOGENEOUS AND TWO MEDIA PLANE GEOMETRY
Burton G. Bennett and Harold L. Beck Aug. 1967 68 p refs
(HASL-185) CFSTI: HC $3.00/MF $0.65

The polynomial expansion matrix equation method for obtaining semi-analytical solutions of the one-dimensional Boltzmann equation has been extended for use with full range Legendre polynomials (P3, P5, P7), Tschebyscheff polynomials (T3, T5) and half-range Legendre polynomials (DP1). Each of the polynomial approximations was used to calculate the differential energy spectra and angular distributions for various gamma-ray source distributions in several scattering media. Comparisons of the infinite medium results were made with the exact calculations at the source energy, a careful experimental measurement of the energy spectrum from a 0.662-MeV point isotropic source in an effectively infinite water medium, the differential energy spectra and buildup factors from Goldstein and Wilkens' moments method calculations, and with the angular distributions from a moments method calculation for a 1-MeV plane isotropic source. The comparisons of these results show good agreement. Author (NSA)

N68-14121# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
ELECTRIC QUADRUPOLE MOMENTS OF THE FIRST 2^+ STATES OF EVEN NUCLEI
A. S. Davydov and V. I. Ovcharenko 1967 25 p refs
(ITF-67-14)

It is shown that the theory of collective excited states of non-spherical even nuclei taking into account the nuclear deformability agrees quantitatively with experimental values of the average electric quadrupole moments for the first 2^+ excited states. NSA

N68-14123 National Institutes of Health, Bethesda, Md. Circulation Unit.
NEW SCINTILLATION MATERIALS FOR DOSIMETRY OF X AND GAMMA-RADIATION
S. P. Vershinina, G. P. Zaplesnichenko, L. N. Kolesnikov, Zh. V. Ckooratovckaya, A. V. Chernobai et al 29 Mar. 1964 5 p refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 10, no. 4, 1965 p 73–74
(Rept.-11-42-67)

The dosimetric properties of several combined scintillation detectors consisting of scintillating plastic with additions of zinc sulfide (silver activated), calcium iodide (thallium activated), cesium iodide (thallium activated), calcium bromide, sodium chloride, calcium chloride, tetraphenyl lead, and tetraphenyl tin; are reported. Applications of these materials in the dosimetry of X-irradiation and gamma radiation in the interval from 0.03 to 3 MeV, are discussed. S.C.W.

N68-14127# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Lab.
FOUR-DIMENSIONAL SPACE WITH $SU(3)/Z_3$ SYMMETRY
Dave Pandres, Jr. May 1967 13 p refs *Its* DARL Res. Commun. No. 31
(Douglas Paper-4579; NP-17076)

The lowest dimensional Riemann space which admits $SU(3)/Z_3$ as its group of motions is obtained. This is a real four-dimensional compact Einstein space with positive–definite metric. The metric and the imbedding of the space into the eight-dimensional group space are given explicitly. Author (NSA)

N68-14128# Pennsylvania Univ., Philadelphia. Dept. of Physics.
THEORETICAL AND EXPERIMENTAL RESEARCH ACTIVITIES IN HIGH-ENERGY PHYSICS Progress Report, Sep. 1966–Sep. 1967
28 Sep. 1967 50 p refs
(Contract AT(30-1)-2171)
(NYO-2171-233) CFSTI: HC $3.00/MF $0.65

A summary of investigations in theoretical and experimental elementary particle physics and nuclear theory is given. This research includes methods in nuclear shell structure theory, non-leptonic hyperon decay studies, the K_{13} form factors, high-energy scattering theory, the effect of pion exchange in nuclear weak interactions, and work on several model theories. NSA

N68-14133# Rochester Univ., N. Y. Dept. of Physics and Astronomy.

NEW APPROACH TO ALGEBRA OF CURRENT AND WEINBERG SUM RULES

Susumu Okubo 22 Aug. 1967 19 p refs Presented at Intern. Theoret. Phys. Conf. on Particles and Fields, Rochester, N. Y., Aug. 1967

(Contract AT(30-1)-875)

(UR-875-214) CFSTI: HC $3.00/MF $0.65

Two rather separate subjects of the algebra of currents are discussed. The first one is a proposal to use the algebra of currents only for determining subtraction constants in once-subtracted dispersion theory of two-body decay modes such as $K \rightarrow 2\pi$, $A \rightarrow N\pi$, or $\rho \rightarrow 2\pi$. In this way, hitherto neglected corrections are computed. Also, in the technique, allowing $k \rightarrow 0$ directly is avoided (k being the four-momentum of the pion) but rather $k^2 \rightarrow 0$ is allowed. Hence, for example, in $K \rightarrow 2\pi$ decay one does not have the troublesome neglect of the kaon–pion mass difference which results as a consequence of the energy–momentum conservation in the ordinary method. The second topic is mainly devoted to a generalization of Weinberg sum rules, taking account of SU(3)-violating interactions at high energy. In this way the decay rates of $\omega \rightarrow 1\bar{1}$, $\phi \rightarrow 11$, $K^* \rightarrow K\pi$, and $\phi \rightarrow K\bar{K}$ were computed, and they are compared with experiment. Also ordinary SU(3) mass formulas were rederived from this new viewpoint.

Author (NSA)

N68-14169# Columbia Univ., Irvington, N. Y. Nevis Labs.

NONORTHOGONALITY OF THE LONG- AND SHORT-LIVED NEUTRAL KAON STATES AND PHENOMENOLOGICAL ANALYSIS OF EXPERIMENTS ON CP VIOLATION IN KAON DECAY

Sheldon Bennett, David Nygren, Harry Saal, Jack Steinberger, and John Sunderland 1967 10 p refs

(Contract AT(30-1)-1932)

(NEVIS-163; CU-1932-267; R-594) CFSTI: HC $3.00/MF $0.65

It is noted that the nonzero charge asymmetry in the $K_{L\pi3}$ decay demonstrates the nonorthogonality of the K_L^0 and K_S^0 states. The result of previous work on the charge asymmetry is then combined with other measurements relevant to CP violation in K decay. It is found that the experimental results are consistent with a phenomenological analysis. The pion–pion scattering phase shift which follows from this analysis is consistent with other indirect observations only if the mass difference $m_L - m_S$ is negative.

Author (NSA)

N68-14186# Brookhaven National Lab., Upton, N. Y. Cross Section Evaluation Center.

MULTILEVEL ANALYSIS OF THE U^{235} TOTAL AND FISSION CROSS SECTIONS IN THE ENERGY REGION BELOW 37 EV

D. B. Adler and F. T. Adler Mar. 1967 74 p refs

(BNL-50045(T-455)) CFSTI: HC $3.00/MF $0.65

A multilevel analysis of the neutron fission and total cross sections of ^{235}U for neutron energies below 37 eV is outlined, and the resonance parameters obtained are tabulated. A shape analysis based on the least-squares technique was used. NSA

N68-14194# Idaho Nuclear Corp., Idaho Falls.

MACS M: A PROGRAM FOR COMPUTING THE CRYSTAL DYNAMICAL MATRIX, PHONON DISPERSION RELATIONS, AND STRUCTURE FACTORS FOR NEUTRON INELASTIC SCATTERING

C. Noble (Phillips Petrol. Co.), A. W. Solbrig, Jr., and H. L. McMurry Oct. 1967 36 p refs

(Contract AT(10-1)-1230)

(IN-1125) CFSTI: HC $3.00/MF $0.65

The Fortran IV program MACS M (PPCo 40*0650) computes the dynamical matrix for the harmonic oscillations of a crystal, the eigenvalues and eigenvectors of this matrix, and the corresponding structure factors for coherent single-phonon scattering of neutrons. The calculation of the dynamical matrix is especially adapted to the use of a potential in valence coordinates, but the input allows use of a potential in Cartesian coordinates. Running times on an IBM 7040 (32K, batch processing) for calculating a dynamical matrix and solving the corresponding secular equation are about one minute for diamond (two atoms per primitive cell) and two minutes to three minutes for beryllium oxide (four atoms per primitive cell).

Author (NSA)

N68-14204# California Univ., La Jolla.

SIGN OF THE MASS DIFFERENCE OF NEUTRAL KAONS

W. A. W. Mehlhop, R. H. Good, O. Piccioni, R. A. Swanson, S. S. Murty et al Sep. 1967 13 p Presented at the Intern. Conf. on Elementary Particles, Heidelberg, 20–27 Sep. 1967

(Contract AT(11-1)-GEN-10)

(UCSD-10P10-104; CONF-670934-4) CFSTI: HC $3.00/MF $0.65

In order to discuss the reliability of the determination of the sign of the mass difference of neutral mesons (K), the evidence for the value of the regeneration amplitude and phase used is considered in detail. These values are derived from a scattering experiment using mesons (K^+) and (K^-). Both the elastic differential scattering and the reaction cross section were measured separately. The value of the real and imaginary potentials for the nuclei for positive and negative mesons (K) of a momentum equal to the most probable K^0 momentum in the regeneration experiment was then determined. The values obtained for the various potentials, the amplitudes for elastic scattering and for the regeneration are given.

NSA

N68-14207# California Univ., Berkeley. Lawrence Radiation Lab.

THE (^{3}He,p) AND (α,d), TWO-NUCLEON STRIPPING REACTIONS ON ^{12}C AND ^{16}O: MECHANISM AND NUCLEAR SPECTROSCOPY

Nolan Farrin Mangelson (Ph.D. Thesis) Aug. 1967 171 p refs

(Contract W-7405-ENG-48)

(UCRL-17732) CFSTI: HC $3.00/MF $0.65

Spectra and angular distributions were obtained for the reactions and conditions listed: $^{12}C(^3He,p)^{14}N$ at $E(^3He)$ = 20.1 MeV, from θ_{lab} = 8 to 170° for ^{14}N excited states below 13-MeV excitation; $^{12}C(^3He,^3He)^{12}C$ at $E(^3He)$ = 20.1 MeV, from θ_{lab} = 8.5 to 62.5° for the ground state and 4.433-MeV state of ^{12}C; $^{16}O(^3He,p)^{18}F$ at $E(^3He)$ = 19.8 MeV, from θ_{lab} = 9 to 170° for ^{18}F excited states below 11.3-MeV excitation; $^{16}O(\alpha,d)^{18}F$ at $E(\alpha)$ = 40.3 MeV, from θ_{lab} = 8 to 80° for ^{18}F excited states below 12.7-MeV excitation. Distorted-wave calculations of angular distributions and relative cross sections for the two (^{3}He,p) reactions were compared to experimental values. Agreement was found when a spin-independent interaction potential was used. Nuclear wave functions used in the calculations were discussed. Spectroscopic and configuration assignments were made or confirmed on the basis of excitation energy, angular distribution, comparison of (α,d) and (^{3}He,p) results, relative total cross section, and comparison of experimental quantities to the DW calculations. The following assignments were made for ^{14}N. A spin and parity assignment of 2^- and a tentative assignment of 4^+ were made for the 9.388and 10.85-MeV, T = 0 levels respectively. Suggested configurations were made for the 8.979-, 10.213-, and 10.85-MeV levels. Configurations and J^π values of 3^+ and 4^+ were suggested

for ^{18}F levels at 3.358 and 5.594 MeV, respectively. Configurations and $J^{\pi}T$ values were confirmed for some levels, and T = 0 assignments were made for a large number of levels. A new ^{18}F level at an excitation energy of 8.596 MeV was identified. Author (NSA)

N68-14209# Brookhaven National Lab., Upton, N. Y. Accelerator Dept.
SUPERPERIOD GRADIENT PERTURBATIONS IN THE AGS STUDIED TO SECOND ORDER
S. A. Fulling (Princeton Univ.) 28 Aug. 1967 8 p refs
(BNL-11760; AGSCD-20) CFSTI: HC $3.00/MF $0.65

A computer program, ORDER 2, has bean written to calculate the betatron parameters ν_p, β_p, α_p, and γ_p to first and second order in the case of any superperiod symmetric distribution of point quadrupoles located at the centers of the straight sections of the AGS. First and second order results from this program are compared with exact values computed with the program BEAM. NSA

N68-14220# California Univ., Berkeley. Lawrence Radiation Lab.
MASS AND SPECTROSCOPIC MEASUREMENTS OF COMPLETE ISOSPIN QUARTETS IN THE LIGHT NUCLEI
Gilbert W. Butler (Ph.D. Thesis) 30 Aug. 1967 87 p refs
(Contract W-7405-ENG-48)
(UCRL-17783) CFSTI: HC $3.00/MF $0.65

The mass 13, 21, and 37 isospin T=3/2 quarters were completed through a series of nuclear reaction investigations. A standard particle identifier was used to measure the mass of the $T_z=-3/2$ nuclide ^{13}O via the $^{16}O(^3He,^6He)^{13}O$ reaction at 65 MeV. An improved particle-identification system, which employed two transmission (dE/dx) and one stopping (E) detector, was used to determine the masses of the $T_z=-3/2$ nuclei ^{21}Mg and ^{37}Ca via the $^{24}Mg(^3He,^6He)^{21}Mg$ and $^{40}Ca(^3He,^6He)^{37}Ca$ reactions at 56 MeV. The first three T=3/2 levels in ^{21}Ne and $^{22}Ne(d,^3He)^{21}F$ reactions at 39.6 MeV, while the $^{23}Na(p,t)^{21}Na$ reaction at 42 MeV was utilized to observe the lowest T=3/2 level in ^{21}Na. Excitation energies of the lowest T=3/2 levels in ^{37}K and ^{37}Ar were determined via the $^{39}K(p,t)^{37}K$ and $^{39}K(p,^3He)^{37}Ar$ reactions induced by 45-MeV protons. Data from the complete isospin quartets were used to test the isobaric multiplet mass equation and the various predictions of masses of neutron-deficient nuclei. Author (NSA)

N68-14223# Stanford Univ., Calif. Linear Accelerator Center.
WHAT HAVE WE LEARNED ABOUT ELEMENTARY PARTICLES FROM PHOTON AND ELECTRON INTERACTIONS?
S. D. Drell Sep. 1967 50 p refs Presented at 3d Intern. Symp. on Electron and Photon Interactions at High Energies, Stanford, Calif., Sep. 1967
(Contract AT(04-3)-515)
(SLAC-PUB-355; CONF-670923-2) CFSTI: HC $3.00/MF $0.65

A review is given of electron and photon interactions used for determining elementary particle properties. Several problems are considered, and the main emphasis placed on meson (π) production. NSA

N68-14224# Oak Ridge National Lab., Tenn.
THE MEASUREMENT OF HIGH-ENERGY CHARGE TRANSFER CROSS SECTIONS FOR INCIDENT PROTONS AND ATOMIC HYDROGEN IN VARIOUS GASES AND THE K-, L-, AND M-AUGER, L-COSTER-KRONIG, AND THE CONVERSION-ELECTRON SPECTRA OF PLATINUM IN THE DECAY OF ^{195}Au
L. H. Toburen (Ph.D. Thesis—Vanderbilt Univ.), M. Y. Nakai, and R. A. Langley Nov. 1967 231 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1988) CFSTI: HC $3.00/MF $0.65

In Part I the single-electron capture and loss cross sections are reported for incident protons and atomic hydrogen on the target gases H_2, He, Ar, Kr, N_2, O_2, CO, CO_2, H_2O, CH_4, C_2H_4, C_2H_6, and C_4H_{10}. The incident particle energies were from 100 to 2500 keV. Results of measurement of double-electron capture cross sections for the target gases H_2, He, Ar, Kr, N_2, and H_2O for incident protons with energies in the range 75 to 250 keV are also presented. In Part II ^{195}Pt K-, L-, and M- Auger and L- Coster–Kronig spectra measurements using the Vanderbilt iron-free, double-focusing, β-ray spectrometer are reported. The conversion-electron spectrum in the electron capture decay of ^{195}Au was also recorded using the same spectrometer. In each part, theory, apparatus, and measurement techniques are described, and results are compared with previous experiments and theoretical calculations. NSA

N68-14227# California Univ., Berkeley. Lawrence Radiation Lab.
AVERAGE NUCLEAR PROPERTIES
W. D. Myers and W. J. Swiatecki Aug. 1967 6 p refs Presented at the Intern. Conf. on Nucl. Struct., Tokyo, 7–14 Sep. 1967
(Contract W-7405-ENG-48)
(UCRL-17724; CONF-670910-3) CFSTI: HC $3.00/MF $0.65

A simple nuclear model which is intended to describe all average nuclear properties that do not depend on the discreteness of the nucleons is outlined. The Thomas–Fermi treatment is used, and the nucleon–nucleon interaction is assumed to be a phenomenological Yukawa force. NSA

N68-14235# California Univ., Berkeley. Lawrence Radiation Lab.
RESONANT EXTRACTION STUDIES FOR THE BEVATRON
Yves M. Baconnier and Glen R. Lambertson 8 Sep. 1967 8 p Presented at the 6th Intern. Conf. on High Energy Accelerators, Cambridge, Mass., 11–15 Sep. 1967
(Contract W-7405-ENG-48)
(UCRL-17604; CONF-670930-8) CFSTI: HC $3.00/MF $0.65

An extraction system employing betatron resonance at $\nu_R=2/3$ was studied for the Bevatron. A single perturbing magnet coincident in azimuth with the first septum will be used. The usable growth rate of the radial amplitude is limited by vertical growth through the coupling at $2\nu_z-\nu_R=1$. This limitation, together with the general behavior of the beam, was first studied through a linear theory then checked by computer calculations. An energy loss target may be used in combination with the resonance process to aid in jumping the first septum. A trial system is installed in the Bevatron and results of tests will be reported. Author (NSA)

N68-14237# Tuebingen Univ. (West Germany).
A NUCLEON–NUCLEON SPIN ORBIT POTENTIAL FROM CLUSTER MODEL CALCULATIONS ON LIGHT NUCLEI [BESTIMMUNG EINES ZWEINUKLEONEN-SPIN-BAHN-POTENTIALS AUS CLUSTERMODELLRECHNUNGEN AN LEICHTEN KERNEN]
E. J. Wurster Aug. 1967 83 p refs In GERMAN; ENGLISH summary
(BMwF-FBK-67-69)

The radial dependence of the nucleon–nucleon spin-orbit potential is assumed to be Gaussian; fitting parameters are the width and depth of the potential well. They are determined to

reproduce the experimental elastic α-n phase shifts and the splitting of the ^{7}Li ground state. Using this potential the elastic ^{3}He–^{4}He scattering is investigated; the calculated $7/2^-$ phase shift is in good agreement with the experimental results. Furthermore this spin-orbit potential gives the observed splitting of the ^{3}D-states in ^{6}Li. Author (NSA)

N68-14238# Stanford Univ., Calif. Linear Accelerator Center.
Y* PRODUCTION IN 2.1 AND 2.65 GEV/C K⁻N INTERACTION
G. B. Chadwick, Z. G. T. Guiragossian, E. Pickup, A. Barbaro-Galtieri (Calif. Univ., Berkeley), M. J. Matison (Calif. Univ., Berkeley) et al Sep. 1967 14 p refs Presented at the Intern. Conf. on Elementary Particles, Heidelberg, 20–27 Sep. 1967 Sponsored by AEC
(SLAC-PUB-348; CONF-670934-7) CFSTI: HC$3.00/MF$0.65

The Σ^- and Λ^0 producing channels of K⁻–deuteron interactions at 2.1 and 2.65 GeV/c incident momenta in a deuterium bubble chamber were studied. Among the 3- and 4-prong topologies containing a negatively charged decay, a total of 5822 events for the interactions $K^- + d \rightarrow \Sigma^- + \pi^+ + \pi^-$ and $K^- + d \rightarrow \Sigma^- + \pi^+ + \pi^0 + \pi^-$ were found. Also the 1- and 2-prong with V_0 topologies gave a total of 12,623 successfully processed events. The reactions of interest are $K^- + d \rightarrow \Lambda^0 + \pi^- +$ missing mass and $K^- + d \rightarrow \Lambda^0 + \pi^- + \pi^0$. The various channel cross sections, masses, experimental widths, and amount of resonant states at both energies are listed. NSA

N68-14264# Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab.
ENERGY LOSS DISTRIBUTIONS OF HEAVY PARTICLES IN THICK ABSORBERS
C. Tschalaer Jun. 1967 56 p refs
(RHEL/R-146) CFSTI: HC$3.00/MF$0.65

The energy straggling distributions of nonrelativistic heavy particles traveling through a homogeneous absorber were determined for energy losses up to about 85% of the initial energy. Included are single collision distributions for very small energy losses. The distributions are found to be most symmetrical at energy losses of about 50%. Their asymmetry increases noticeably towards large energy losses. The calculations are valid for initial energies up to about 30% of the particle rest energy. The lower energy limit is determined by the importance of the inner shell corrections to the stopping power which have been neglected in this treatment. Within these energy limits the results apply to any absorber element throughout the periodic system. Author (NSA)

N68-14265# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
EQUATION FOR THE RELATIVISTIC SCATTERING AMPLITUDE
V. G. Kadyshevskii 1967 35 p refs
(ITF-67-7)

A quasipotential equation is derived for the two-body scattering amplitude. When considering the Lorentz-invariant amplitudes a somewhat different normalization, which is more convenient for the relativistic case, is used. The corresponding integral equations involve factors which do not transform to unity in the nonrelativistic limit. The derivation shows that this equation plays the same role in the formalism as the Bethe–Salpeter equation in an ordinary treatment. Under these circumstances the kernel of the equation obtained, the so-called quasipotential, can be constructed from perturbation theory by making use of irreducible diagrams of definite form. NSA

N68-14276# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
QUANTUM FIELD MODEL WITH UNRENORMALIZABLE INTERACTION
M. K. Volkov 1967 23 p refs
(JINR-E2-3472)

The unitary relativistic model of quantum field theory with rapidly increasing spectral function (i.e. it grows faster than any finite power of momentum) is investigated. It is shown that there exist nontrivial Lagrangians, leading to this kind of spectral function and allowing one to construct the local theory without the ultraviolet divergences on their basis. In this theory the S-matrix is unitary and not equal identically to unity. Author

N68-14280# California Univ., Berkeley. Lawrence Radiation Lab.
MEASUREMENT OF THE Σ^+ MAGNETIC MOMENT
Terry S. Mast, Margaret Alston-Garnjost, Roger O. Bangerter, Angela Barbaro-Galtieri, Lawrence K. Gershwin, et al 15 Aug. 1967 6 p refs Presented at the Intern. Conf. on Elementary Particles, Heidelberg, 20–27 Sep. 1967
(Contract W-7405-ENG-48)
(UCRL-17746; CONF-670934-3) CFSTI: HC$3.00/MF$0.65

The Σ^+ magnetic moment was measured by observing the precession of polarized sigmas in the magnetic field of the hydrogen bubble chamber. From an exposure of 1.2 (10)^6 pictures, 31,000 events of the type $K^- + p \rightarrow \Sigma^+ + \pi^-$, $\Sigma^+ \rightarrow p + \pi^0$ were analyzed. The incident momenta range from 340 to 430 MeV/c. NSA

N68-14281 European Organization for Nuclear Research, Geneva (Switzerland).
INTERNATIONAL COLLOQUIUM ON BUBBLE CHAMBERS, VOLUME 1
H. Leutz, ed. Aug. 1967 364 p refs Conf. held at Heidelberg, 13–14 Apr. 1967
(CERN-67-26, V. 1)

The latest developments in the field of bubble chamber techniques are discussed in this conference. Papers presented cover the physics aspects, present and future projects, and optical illumination and measuring methods. G.G.

N68-14282 Paris Univ., Orsay (France).
FUTURE OF NEUTRINO PHYSICS WITH LARGE CHAMBERS
A. Lagarrigue *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 21 p refs (See N68-14281 05-24)

Future high energy experiments on neutrinos require improved proton beams with increased repetition rates and the replacement of the old injection system by a neutrino beam with better pion focusing. Increased event rates also require a larger chamber volume in order to detect neutral particles. Either hydrogen or heavy liquid chambers are feasible for this purpose. The known number of events for every channel in the CERN runs is used to compute the expected number of events in future runs with large chamber volumes filled by heavy freon; pure propane for free proton and bound nucleon events; and for proposed events in hydrogen or deuterium. G.G.

N68-14284 European Organization for Nuclear Research, Geneva (Switzerland).
THE DETECTION OF π^0 MESONS, NEUTRONS AND NEUTRIONS AT THE 300 GeV ACCELERATOR

H. Leutz *In its* Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 23 p refs (See N68-14281 05-24)

A cylindrical shaped large cryogenic bubble chamber of about 15 m diameter, a vertical symmetry axis, and a height of about 4 m at the 300 GeV accelerator is proposed for the detection of neutral pion-mesons, neutrons, and neutrinos. The chamber can be filled with hydrogen or with neon-hydrogen mixtures for the required observations and appropriate beam targets can be mounted inside the chamber. The preferred optical system should photograph the volume of the flat cylindrical chambers with four or five cameras at the bottom or top, and the superconducting coils should be arranged in circular windings around a vertical axis. G.G.

N68-14310# Yale Univ., New Haven, Conn.

THE LYTTLETON-BONDI UNIVERSE AND CHARGE EQUALITY

V. W. Hughes *In* NASA. Goddard Inst. for Space Studies Lectures on Gravitation and Relativity, Vol. 2 [1966] 41 p refs (See N68-14304 05-23)

The theoretical arguments on whether or not the electron charge magnitude exactly equals the proton charge magnitude are discussed. Included are considerations of its implications to physics, astronomy and cosmology of a slight departure from charge equality, and the most recent experimental determinations of the electron–proton charge ratio. C.T.C.

N68-14314# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

QUANTUM PHASE GEOMETRY [KWANTOWA GEOMETRIA FAZOWA]

Z. Chylinski 1967 56 p refs In POLISH

(INR-824/6/PH)

A new geometrical framework is proposed called the phase geometry. It provides us with a parametrization of the internal degrees of freedom of isolated systems which results in the modification of interaction of high-energy particles. Author (NSA)

N68-14317# Bettis Atomic Power Lab., Pittsburgh, Pa.

HIGH-ORDER TRANSPORT RESULTS FOR GAMMA RAYS IN MULTILAMINAR GEOMETRY

L. Lois Sep. 1967 10 p refs Presented at the 15th Conf. on Remote Systems Technol. and Atom Fair, Chicago, Nov. 1967

(Contract AT(11-1)-GEN-14)

(WAPT-T-2057; CONF-671102-26) CFSTI: HC $3.00/MF $0.65

A digital computer program called LETO was written for γ-ray transport calculations in multilaminar geometry. The program is based on a formulation for the solution of the Boltzmann transport equation, which employs the double range Legendre polynomial expansion of the flux to obtain a round-off free analytic solution for the single-region monoenergetic problem. Buildup factors for 1- and 3-MeV plane and point isotropic sources in Fe and Pb are given and compared with results from the moments method. Results for a 6-MeV plane isotropic source in Pb are compared with the moments method and with a P-3 spherical harmonics calculation by Lanning. Comparison is also made with the results of Monte Carlo calculations in an iron–water laminar array. The agreement obtained implies that LETO can successfully cope with alternating material regions. LETO can supply, in addition, pointwise energy deposition and angular distributions. NSA

N68-14339# Atomic Weapons Research Establishment, Aldermaston (England).

THE LIFE OF TRITIUM TARGETS UNDER DEUTERON BOMBARDMENT IN AN ACCELERATOR

D. L. E. Smith Sep. 1967 17 p refs

(AWRE-O-52/67) CFSTI: HC $3.00/MF $0.65

Life tests have been conducted on titanium tritide and erbium tritide targets when bombarded with deuterium ions. The 14-MeV neutron output from these targets falls as the total integrated current on them increases. A secondary source of 2.5-MeV neutrons builds up rapidly, then remains at a steady level. Author (NSA)

N68-14341# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

SYMMETRY BREAKING QUASIPARTICLE METHOD FOR BARYONS AND FOR QUARKS. 2: RESONANCE SCATTERING PROBLEM

K. S. Wohlrab 1967 28 p refs

(JINR-E2-3454)

The resonance scattering of those particles, which were described previously as bound states of baryons or quarks with the help of the quasiparticle approximation is treated. Simple interactions between physical particles are written down, and a finite nonperturbational renormalization of 4-fermion interactions results. So this method disentangles the problem of resonances from the divergency problem. The K- and S-matrix for resonance scattering is calculated, leading to a Breit–Wigner formula with resonances just at the masses of those physical particles (resonances), which are possible intermediate states of the scattering process. The method shows interesting connections with polylocal fields and with the Newton–Wigner localization problem. Author (NSA)

N68-14342# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

TIME SYNTHESIS: A STUDY OF SYNTHESIS MODES AND WEIGHTING FUNCTIONS

Roger A. Rydin 7 Nov. 1967 25 p refs Presented at the 15th Conf. on Remote Systems Technol. and Atom Fair, Chicago, Nov. 1967

(Contract W-31-109-ENG-52)

(KAPL-P-3392; CONF-671102-31) CFSTI: HC $3.00/MF $0.65

The Time-Synthesis Method has been used to investigate the effects of the choice of trial functions and weighting functions on the results of synthesis calculations. It was found that the time-dependent total power in a reactor could be adequately predicted using any of the methods of weighting considered (region-balance, flux, or adjoint), but that the spatial flux distribution was more difficult to synthesize. In particular, region-balance weighting did not give very good spatial results, flux weighting gave better results which were sensitive to the group spectra, and adjoint weighting gave the best results. A singularity in the total removal matrix was observed during the course of the transient in one of the adjoint weighted problems. The synthesis results were sensitive to the choice and number of trial functions used. In particular, the asymptotic flux shape, corresponding to the final state of the reactor, was not the best mode to use because of delayed neutron holdback effects. Similarly, the addition of transition modes between the initial and final states were beneficial in improving the time-dependent flux shapes calculated early in the transient. Qualitative criteria were developed for choosing synthesis modes based upon the initial eigenvalue separation of the core, the time scale of the transient relative to the delayed neutron half-lives, and the total magnitude of the perturbation. Author (NSA)

N68-14343# California Univ., Berkeley. Lawrence Radiation Lab.

SINGLE AND DOUBLE ELECTRON CAPTURE BY 7.7- TO 166-keV $^3He^{++}$ IONS IN N_2

John Warren Stearns (M.S. Thesis) 11 Sep. 1967 34 p refs

(Contract W-7405-ENG-48)

(UCRL-17756) CFSTI: HC $3.00/MF $0.65

The cross sections, σ_{21} and σ_{20} for single and double electron capture of $^3He^{++}$ ions with energies between 7.7 and 166 keV have been measured in thin targets of N_2. The $^3He^{++}$ ions were extracted from an rf source and accelerated electrostatically. After momentum analysis by a 90° magnet, they passed through the target chamber and were reanalyzed electrostatically. The charged components, $^3He^{++}$ and $^3He^+$, were detected by a pair of Faraday cups, and the neutral component $^3He^0$ by a CsI(Tl) crystal mounted on a photomultiplier tube. Currents from these detectors were simultaneously integrated, and measurements were made for at least eight pressures at each energy. Pressures were measured with a capacitance manometer. Both σ_{21} and σ_{20} have maxima at about 50 keV, which are $\sigma_{21} = (13.0 \pm 1.3) \times 10^{-16}$ and $\sigma_{20} = (3.3 \pm 0.7) \times 10^{-16}$ cm^2/molecule. The results agree with those of Allison for $^4He^{++}$ in the region where the velocities overlap ($^3He^{++}$ energies between 112.5 and 166 keV). The results are compared with available theoretical models. Author (NSA)

N68-14350# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SUM RULES IN γD FORWARD SCATTERING [PRAVILA SUMM I γD RASSEYANIE VPERED]
K. Levin and D. Robashik 1967 9 p refs In RUSSIAN
(JINR-P4-3450)

For γd forward scattering a family of sum rules is obtained. Two of them are sum rules for the anomalous magnetic moment and the electric quadrupole moment of the deutron. Author (NSA)

N68-14351# Academy of Sciences (USSR), Moscow. Inst. of Atomic Energy.
POLARIZATION EFFECTS IN PROCESSES WITH PARTICIPATION OF HIGH-ENERGY NEUTRINOS, 2 [POLYARIZATSIONNYE EFFEKTY V PROTSESSAKH S UCHASTIEM NEITRINO VYSOKIKH ENERGII, 2]
V. A. Lyul'ka 1966 33 p refs In RUSSIAN
(IAE-1241)

Polarization effects are examined in reactions induced by high-energy neutrinos, of the types $\nu + p \rightarrow \Lambda + 1^+$, $\nu + p \rightarrow \Sigma^0 + 1^+$ and $\nu + p \rightarrow n + 1^+$, where 1 is a lepton; therefore questions connected with different types of neutrino are not considered. The various possibilities of the use of polarized targets to study such processes are considered. NSA

N68-14352# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE UPPER LIMIT OF THE RADIUS OF ELEMENTARY PARTICLES
Nguyen Van Hieu 1967 8 p refs Submitted for publication
(JINR-E2-3509)

Some upper bounds are obtained for the mean square radius of the elementary particles depending on the behavior of the modulus of the form factor on the cut. Author (NSA)

N68-14356# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON WAVE FUNCTIONS OF UNSTABLE PARTICLE
J. Jersak 1967 11 p refs Submitted for publication
(JINR-E2-3470)

It is shown that wave functions describing an unstable particle must obey a simple condition which leads to the relation between the number of these wave functions and decay laws of the particle. Author (NSA)

N68-14358 European Atomic Energy Community, Geel (Belgium).
PROGRAMMES FOR FISSION CROSS-SECTION EVALUATION FROM RAW EXPERIMENTAL DATA [PROGRAMMES POUR L'EVALUATION DE LA SECTION EFFICACE DE FISSION A PARTIR DES DONNEES EXPERIMENTALES BRUTES]
M. G. Cao Dec. 1967 122 p refs In FRENCH; ENGLISH summary
(EUR-3652.F)

All the programs described in this report can be used to obtain the fission cross-section σ' from raw experimental data provided by analyzers relative to the fission neutron spectrum, fission background noise, neutron flux and the flux background noise spectrum. Apart from the program for plotting the σ' curve (Plot), all the programs were written for the IBM 1401 computer. The language used was SPS and the French Fortran. The Plot program was written in Fortran II version 3 for the IBM 7090 computer. Author

N68-14361# Brookhaven National Lab., Upton, N. Y.
PROPERTIES OF NUCLEI IN THE TRANSITION REGION
G. Scharff-Goldhaber 29 Sep. 1967 18 p refs Presented at the Intern. Conf. on Nucl. Struct., Tokyo Sponsored by AEC
(BNL-11796; CONF-670910-4) CFSTI: HC$3.00/MF$0.65

The level structure of nuclei in the transition region is discussed, considering both experimental observations and theoretical interpretations. Some recent observations on the β-vibrational bands in these nuclei are summarized, and a description of ground-state bands in even–even nuclei that is based on an axially symmetric rotor model is outlined. NSA

N68-14406# California Univ., Berkeley. Lawrence Radiation Lab.
BEAM LOSS AND SHIELDING EXPERIMENTS RELEVANT TO HIGH ENERGY PROTON SYNCHROTRONS
William S. Gilbert 7 Sep. 1967 13 p refs Presented at the 6th Intern. Conf. on High Energy Accelerators, Cambridge, Mass., Sep. 1967
(Contract W-7405-ENG-48)
(UCRL-17797; CONF-670930-12) CFSTI: HC$3.00/MF$0.65

Beam loss distribution and shielding experiments are described in order to evaluate the radiation problems associated with the contemplated 200-GeV strong-focusing proton synchrotron. NSA

N68-14407# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
PHENOMENOLOGY OF $K^0 \rightarrow 2\pi$ DECAY AND REGENERATION OF K^0 MESONS [FENOMENOLOGIYA $K^0 \rightarrow 2\pi$ RASPADA I REGENERATSIYA K^0 MEZONOV]
L. I. Lapidus 1967 31 p refs In RUSSIAN Submitted for publication
(JINR-P2-3513)

Phenomenology of the $K^0 \rightarrow 2\pi$ decay mode and the results of the regeneration and interference experiments on the investigation of the CP-invariance violation are discussed. The Bell and Steinberger's unitarity relation for K^0-decay in vacuum and the consequences following from this relation are considered. Author (NSA)

N68-14417# Sandia Corp., Albuquerque, N. Mex.
TWO-CENTER PROBLEM OF QUANTUM MECHANICS, PART 1

L. I. Ponomarev and T. P. Puzynina [1967] 28 p refs Transl. from Joint Inst. for Nucl. Res. Rept. No. JINR-P2-3009
(SC-T-67-0952; JINR-P2-3009) CFSTI: HC$3.00/MF$0.65

The results of numerical calculations of the two-center problem of quantum mechanics are given. Some interesting properties of the systems Z_1eZ_2 are observed for the $Z_1=1$ and $Z_2=3$, ..., 8 values. In particular the existence of the σ-term intersections in such a system, which were previously predicted by theory, is proved. The existence of stable states of molecular ions for large distances between the nuclei Z_1 and Z_2 is proved. Such a peculiar phenomenon, pseudointersections of terms, having no dynamical nature is found out. Possible applications of the results obtained are discussed. Author (NSA)

N68-14418# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
METHOD OF ABSOLUTE GAMMA SOURCES ACTIVITY. MEASUREMENT USING A SCINTILLATION COUNTER IN FIXED GEOMETRY
K. Zarnowiecki 1967 13 p refs
(INR-799/19/NT)

It was calculated that the efficiency of a gamma scintillation counter is lower than one obtained from a simple exponential formula. The influence of escape of the fluorescence x-rays and annihilation photons and the presence of low energy Compton electrons was taken into account. It was proved that a counter in collimated geometry can be used for the absolute measurements of gamma source activity. The method of calculating the correction factors for filters and a collimator permeability are given. The experimental results agree very well with the theoretical calculations. Author (NSA)

N68-14422# Los Alamos Scientific Lab., N. Mex.
SPECTRUM OF GAMMA RAYS FOLLOWING THE CAPTURE OF THERMAL NEUTRONS BY PLATINUM
L. V. Groshev, A. M. Demidov, and A. S. Rakhimov 1967 14 p refs Transl. into ENGLISH from Rept.-IAE-1386
(LA-TR-67-80; IAE-1386) CFSTI: HC$3.00/MF$0.65

A magnetic Compton spectrometer with resolution of 0.3% was used to measure the spectrum of γ rays originating in a natural mixture of platinum isotopes during irradiation with thermal neutrons. A table of the energies and intensities of the measured gamma lines is given. The main part of these γ lines belongs to the emitting isotope ^{196}Pt. On the basis of the data obtained, a level scheme of ^{196}Pt up to an excitation energy of $\approx$3 MeV is proposed. The structure of the γ-ray spectra in the region from 4 to 6.5 MeV with the trend to the doubly magic ^{208}Pb nucleus is discussed. Author (NSA)

N68-14423# Technische Univ., Berlin (West Germany). Physikalisches Inst. (1).
ELASTIC ENERGY LOSSES OF ELECTRONS SCATTERED ON A SOLID [ELASTISCHE ENERGIEVERLUSTE VON AN FESTKOERPERN GESTREUTEN ELEKTRONEN]
H. Schoenebeck and R. Wolter Jul. 1967 9 p refs In GERMAN; ENGLISH summary
(BMWF-FBK-67-64)

Elastic energy losses due to scattering of medium-energy electrons (25 to 45 keV) by solids into large angles ($\geq$45°) are experimentally and theoretically investigated. Energy losses up to a few electron volts appear, which depend on the mass of the atoms, of the scattering angle, and of the primary energy of the electrons. These results agree with the assumption of elastic scattering by single atoms and not by the solid as a whole. The width of the energy losses increases with the energy loss itself, and with the temperature of the solid. In a first theoretical approximation this effect can be explained by the thermal motion of free atoms. Author (NSA)

N68-14427# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
MEASUREMENTS OF THE QUALITY FACTOR FOR HIGH ENERGY PROTONS IN THE WATER PHANTOM [IZMERENIE FAKTORA KACHESTVA PROTONOV VYSOKIKH ENERGII V VODNOM FANTOME]
M. Zel'chinskii, M. M. Komochkov, B. S. Sychev, and A. P. Cherevatenko 1967 10 p refs In RUSSIAN
(JINR-P9-3369)

The depth distribution of the quality factor (QF) for high-energy protons is found experimentally. The measurements were made by use of the tissue-equivalent recombination chamber, moved along the axis of the cylindrical 80-liters phantom. Values of QF for protons with energy 660 and 260 MeV are 1.8 ± 0.3 and 1.2 ± 0.2, respectively, and vary with the depth very slightly, increasing only in the region of the end of primary proton range. Author (NSA)

N68-14430# California Univ., Berkeley. Lawrence Radiation Lab.
CONFIRMATION OF THE L-MESON BY USE OF A HYDROGEN BUBBLE CHAMBER AS A MISSING MASS SPECTROMETER
Alexander Firestone, Gerson Goldhaber, and Benjamin C. Sen 14 Sep. 1967 12 p refs Presented at the Intern. Conf. on Elementary Particles, Heidelberg, 20–27 Sep. 1967
(Contract W-7405-ENG-48)
(UCRL-17833; CONF-670934-5) CFSTI: HC$3.00/MF$0.65

The 80-inch BNL liquid hydrogen bubble chamber was used as a missing mass spectrometer in K^+p interactions at 9 BeV/c, and for those events with stopping-protons, the existence of the L-meson with observed mass M=1740 MeV and full width at half maximum Γ=120 MeV is confirmed. Author (NSA)

N68-14431# Minnesota Univ., Minneapolis. John H. Williams Lab. of Nuclear Physics.
[NUCLEAR PHYSICS] Annual Report, 1967
Aug. 1967 168 p refs
(Contract AT(11-1)-1265)
(COO-1265-49) CFSTI: HC$3.00/MF$0.65

The experimental research program, dealing with elastic and inelastic scattering and with pickup and stripping reactions, is summarized together with optical-model studies. Developments in detectors, targets, scattering chambers, and electronic instrumentation are reported together with the operation and modification of the linear accelerator and the tandem Van De Graaff accelerator. NSA

N68-14435# Miami Univ., Coral Gables, Fla. Center for Theoretical Studies.
SELF-COUPLED REPRESENTATIONS OF THE LORENTZ GROUP AND INFINITE-COMPONENT FIELDS
Ivan T. Todorov Sep. 1967 40 p refs
(CTS-HE-67-6)

A concise review of recent work on infinite-component fields is presented. Attempts to dispense with the restriction of finite-component fields and finite-dimensional representations of SL(2,C) for the covariance law for the field in relativistic quantum field theory are reviewed, and infinite-component quantized fields are considered. It is found that many results of conventional quantum field theory such as TCP and spin and statistics crucially depend on the assumption that a certain transformation in the covariance law for the field in relativistic quantum field theory is finite dimensional. NSA

N68-14438# Academy of Sciences (USSR), Moscow.
EXCITATION OF VIBRATIONAL LEVELS OF EVEN–EVEN NUCLEI IN α DECAY [VOZBUZHDENIE VIBRATSIONNYKH UROVNEI CHETNOCHETNYKH YADER PRI AL'FA-RAS-PADE]
V. G. Nosov 1966 49 p refs In RUSSIAN; ENGLISH summary
(IAE-1266)

The theory of α decay of nonspherical nuclei which was previously developed by the author is generalized to cover the case when the states arising in a daughter nucleus are vibrational in nature. A comparison with experimental data for even–even nuclei is claimed to furnish important information on the static and dynamic characteristics of heavy nuclei. A number of equations are derived for excitation of vibrational levels in nonspherical nuclei, octupole oscillation of nonspherical nuclei, fully symmetrical (beta) oscillations, quadrupole (gamma) oscillations, and phase transformations of spherical into nonspherical nuclei. The course of zero-amplitude oscillations of octupole deformation was determined for nuclei with nonspherical equilibrium configuration from the negative evenness excitation levels. An evaluation is given of the probability of occurrence of two-background octupole excitation which has not yet been discovered experimentally. In the case of gamma oscillation, an explanation is given of the nature of the prohibition due to which the population of the corresponding single-background level in α decay was not observed experimentally. The probability of this process was computed. The field of nuclei with the spherical equilibrium form is examined. The course of quantum fluctuations in quadrupole deformation is reported to be in agreement with the data on electrical quadrupole transitions between the corresponding vibrational levels. The internal probability of the formation of an α particle at the point of transformation of nonspherical into spherical nuclei is said to increase by an order of magnitude. This is seen as evidence of more profound changes in the properties of the energy spectrum of a nucleus in the course of the phase transition process described earlier. Quantum fluctuation of the various transformations of the nucleus in the vicinity of the phase transition point is considered possible. NSA

N68-14473* Oak Ridge National Lab., Tenn.
PRELIMINARY DATA FROM INTRANUCLEAR CASCADE CALCULATIONS OF 0.75, 1, AND 2-GEV PROTONS ON OXYGEN, ALUMINUM, AND LEAD, AND 1-GEV NEUTRONS ON THE SAME ELEMENTS
Hugo W. Bertini Dec. 1967 791 p refs
(NASA Order R-104(1))
(NASA-CR-91811; ORNL-TM-1996) CFSTI: $3.00 CSCL 20H

A limited amount of data was generated from an intranuclear-cascade calculation that is in preliminary form. These data include the total nonelastic cross sections, the cascade and evaporation particle multiplicities, the cascade and evaporation particle energy spectra, the cascade particle angular distributions, the radiochemical cross sections, etc., from 0.75-, 1-, and 2-GeV protons on oxygen, aluminum, and lead, and 1-GeV neutrons on the same elements. Author

N68-14484# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
INTEGRAL REPRESENTATIONS OF VACUUM EXPECTATION VALUES INVOLVING LOCAL COMMUTATIVITY
V. P. Gachok 1967 40 p refs
(ITF-67-16)

A further investigation into the integral representations of vacuum expectation values for products of field operators obtained by G. Kallen and Wilhelmsson (Dan. Math. Fys. Medd., I, No9 (1959)). Integral representations are constructed in the Hilbert space generated by a Wightman functional, defined in a region of completely spatially separated four-vectors. To construct integral representations, expansions in elementary positive-definite kernels associated with a set of commuting self-adjoint operators are used. Afterward these integral representations are extended to the whole space by analytic continuation. There is an isomorphism between these extensions and the extensions of a set of operators of the field type to that of commuting self-adjoint operators. The results permit generalization of those due to Ruelle and deeper investigation of the problem of the existence of phases in statistical mechanics. NSA

N68-14485# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
MATRIX ELEMENTS OF THE HAMADA JOHNSTON POTENTIAL FOR THE HARMONIC OSCILLATOR WAVE FUNCTIONS
J. Blank and I. N. Kuchtina 1967 89 p refs
(JINR-E4-3445)

Matrix elements of the regular part of the Hamada–Johnston-potential (outside the hard core) were calculated for the radial functions of a spherical harmonic oscillator for five values of oscillator frequency which are chosen according to the shell-model data of this quantity for nuclei ^{4}He, ^{16}O, and ^{40}Ca. Author (NSA)

N68-14489# Cornell Univ., Ithaca, N. Y.
COHERENT STATE AND ITS APPLICATION TO QUANTUM STATISTICAL MECHANICS
Kian Seng Dy (Ph.D. Thesis) Jun. 1967 63 p refs
(Contract AT(30-1)-3699)
(NYO-3699-16) CFSTI: HC $3.00/MF $0.65

The purpose of the present work is to exhibit the utility of coherent states basis in quantum statistical mechanics. The mathematical techniques which make the application of the coherent states possible are developed. The connection between the coherent states representation and classical mechanics is established. Applications are extended to nonequilibrium statistical mechanics. Specifically, the system of phonon excitations in an anharmonic solid is considered. Transport theory in the coherent states representation is considered. The problem of phonon scattering by impurities is considered in an appendix. NSA

N68-14490# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
AN EXAMPLE OF ACAUSAL AND UNITARY SCATTERING MATRIX [PRIMER AKAUZAL'NOI I UNITARNOI MATRITSY RASSEYANIYA]
D. I. Blokhintsev and V. M. Vinogradov 1967 7 p refs In RUSSIAN
(JINR-P2-3506)

In the assumption of the coupling constant smallness an example of an acausal S-matrix is given, which is unitary, satisfies macro-causality, and its matrix elements have no peculiarities in the coordinate representation, at least in the approximation considered. Author (NSA)

N68-14493# Brookhaven National Lab., Upton, N. Y.
TIME-DEPENDENT NEUTRON THERMALIZATION IN FINITE MEDIA
John J. Dorning (Ph.D. Thesis—Columbia Univ., N. Y.) Mar. 1967 208 p refs
(BNL-11680) CFSTI: HC $3.00/MF $0.65

An investigation is made of the time-dependent behavior of the thermal neutron flux following the introduction of a burst of neutrons into a finite moderating medium. A simple isotropic

one-term degenerate scattering kernel is assumed, and the resulting transport operator is examined in detail. The integral form of the space-, energy-, and time-dependent transport equation in slab and spherical geometries is utilized in proving four theorems which determine the nature of the time decay constants as a function of system size. The theorems are then verified by actual calculation of the decay constants. Estimates of the energy, angle, and spatial dependence of the solutions are also obtained. The basic principles of slow-neutron scattering theory are reviewed, and modern scattering models for light water are discussed. The discrete-ordinates method for solution of the neutron transport equation is then described. Following this, the results of fundamental mode decay constant calculations for spherical geometries using realistic H_2O scattering models are reported and compared with experiments. The agreement is found to be quite good. Author (NSA)

N68-14495# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ON THE DISPERSION SUM RULES IN THE THEORY OF STRONG INTERACTIONS

L. D. Soloviev 1967 23 p refs Presented at the Intern. Theoret. Phys. Conf. on Particles and Fields, Rochester, N. Y., 28 Aug.–1 Sep. 1967

(JINR-E2-3511; CONF-670824-2)

Problems of applications and main results of the dispersion sum rules based on superconvergence and on the Regge pole hypothesis are considered. Author (NSA)

N68-14514# Kernforschungsanlage, Karlsruhe (West Germany).

ENERGY AND TEMPERATURE DEPENDENT CAPTURE MEASUREMENTS BELOW 30 KEV SUPPORTING DOPPLER EFFECT CALCULATIONS

H. Seufert and D. Stegemann Oct. 1967 27 p refs

(KEK-631; SM-101/17; EUR-3675.E)

Energy and temperature dependent capture measurements below 30 keV neutron energy have been performed in natural uranium, tungsten, and tantalum using the slowing down time spectrometer technique. The experimental setup used for the experiments consists of a lead block of 1.3 m side length containing two experimental channels of 10×10 cm^2 cross-section. Into the first channel the target of a 14 MeV neutron generator is introduced, whereas the second channel is used for insertion of the heated samples. Pulses of 14 MeV-neutrons, having a pulse width of about 1 μsec are used. The neutron energy is degraded first by inelastic collisions; afterwards only elastic collisions take place so that a specific relationship holds between mean neutron energy in the lead pile and the time after occurrence of the neutron pulse. Due to this time–energy relation a time analysis procedure for the detector counts is applied. Author

N68-14515# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Chemistry.

NUCLIDE PRODUCTION BY COSMIC RAYS IN METEORITES AND ON THE MOON

Truman P. Kohman and Michael L. Bender Aug. 1967 77 p refs Presented at the Symp. on High-Energy Nucl. Reactions in Astrophys., Philadelphia, 20 Jan. 1967

(Contract AT(30-1)-844)

(NYO-844-72; CONF-670120-1) CFSTI: HC $3.00/MF $0.65

A survey is given of the observation of products and rates of nuclear reactions in thick solid targets produced by cosmic radiation in space and by protons artificially accelerated to high energies. Methods used previously for calculating nuclide production rates in meteorites and on the lunar surface are reviewed. To systematize the radiochemical data on nuclear reaction rates in accelerator bombardments of thick targets by collimated proton beams, a model was developed. The resulting equation has 10 parameters, which are evaluated by a least-squares analysis. This analysis was applied to 25 sets of data from iron targets at 4 proton energies, 0.45, 1, 3, and 6 GeV and, in all cases, satisfactory fits were obtained. Of the four "nuclide parameters," one was found to be the simple cross section at the incident proton energy for high-energy products, and somewhat larger for low-energy products. The other three were correlated with target-product mass-number difference. This enabled estimation of the parameters for other nuclides of interest, particularly ^{10}Be, ^{14}C, ^{26}Al, ^{36}Cl, and ^{53}Mn. A procedure was developed for calculating production rates of nuclides at various depths in spherical iron meteoroids of various sizes exposed to isotropic cosmic radiation, using the nine pertinent parameters at each of the four energies, and weighting each energy according to the integral galactic cosmic-ray-nucleon flux in corresponding intervals above 0.3 GeV per nucleon. The calculated production rates were compared to observed specific activities in iron meteorities by correlation plots between pairs of nuclides: ^{10}Be–^{26}Al, ^{36}Cl–^{26}Al, and ^{53}Mn–^{26}Al. Order-of-magnitude agreement is excellent through there are many specific cases of disagreement. Author (NSA)

N68-14519# Iowa State Univ. of Science and Technology, Ames.

PRECISE MEASUREMENT OF THE INTERNAL CONVERSION COEFFICIENT OF THE 45-KEV TRANSITION IN ^{236}U

Charles Lewis Duke and W. L. Talbert Aug. 1967 80 p refs

(Contract W-7405-ENG-82)

(IS-1683) CFSTI: HC $3.00/MF $0.65

The total internal conversion coefficient of the 45-keV $2^+ \rightarrow 0^+$ transition in ^{236}U was measured by analysis of photon spectra observed, using a well-type NaI(Tl) detector, in coincidence with the 5.115-MeV alpha group from the decay of ^{240}Pu. The alpha spectra from the gating detector were analyzed on a computer using a least squares curve-fitting program to correct for the contribution to the gating from the 5.159-MeV ground-state alpha group. The NaI(Tl) photon efficiency for the transition was calculated using a computer program that included angular correlation effects. The result for the total internal conversion coefficient of the 45-keV E2 transition in ^{230}U was 807 ± 29. This value is in agreement with the theoretical calculations of Rose and Sliv and Band. A pile-up rejection circuit developed for this investigation is described. Author (NSA)

N68-14542# Atomics International, Canoga Park, Calif.

CONVERSION AND MODIFICATION OF 2 PLUS

C. L. Dunford 19 Sep. 1967 10 p refs Sponsored by AEC

(NAA-SR-MEMO-12532) CFSTI: HC $3.00/MF $0.65

The deformed-nucleus optical model code 2 PLUS is used by the Cross Section Project in the analysis of scattering cross sections for heavy even–even nuclides. With the advent of the IBM-360, Model 50, conversion from FORTRAN II to FORTRAN H was necessary. During the conversion, an attempt was made to optimize the coding and relieve some restrictions. In addition a complex coupling instead of a real coupling between the ground state and the first excited level was added. Author (NSA)

N68-14550# Stanford Univ., Calif. Linear Accelerator Center.

EVIDENCE FOR A T = 0 THREE PION RESONANCE AT M ≈ 990 MEV

G. B. Chadwick, Z. G. T. Guiragossian, E. Pickup, A. Barbaro-Galtieri (Calif. Univ., Berkeley), M. J. Matison (Calif. Univ., Berkeley) et al Sep. 1967 13 p refs Presented at the Intern. Conf. on Elementary Particles, Heidelberg, 20–27 Sep. 1967 Sponsored by AEC

(SLAC-PUB-347; CONF-670934-6) CFSTI: HC $3.00/MF $0.65

In a study of the interaction $K^- + n \rightarrow \Sigma^- + \pi^+ + \pi^-$ from an exposure of a 2.1- and 2.65-GeV/c K^- beam in the deuterium bubble chamber, evidence for a resonance in the neutral 3π system at 990 MeV is found. An upper limit on the true width of this state is 55 MeV. This state is tentatively identified as having the same properties as the meson (H). NSA

N68-14573# California Univ., Berkeley. Lawrence Radiation Lab.
SOME THOUGHTS ON STABILITY IN NONLINEAR PERIODIC FOCUSING SYSTEMS
Edwin M. McMillan 5 Sep. 1967 11 p
(Contract W-7405-ENG-48)
(UCRL-17795) CFSTI: HC $3.00/MF $0.65

A brief discussion is given of the long-term stability of particle motions through periodic focusing structures containing lumped nonlinear elements. A method is presented whereby one can specify the nonlinear elements in such a way as to generate a variety of structures in which the motion has long-term stability. Author (NSA)

N68-14578# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
SUPER HIGH ENERGY PHYSICS ON SATELLITES (SHEPOS)
John P. Dooher and Anthony J. Favale Dec. 1967 31 p refs
(RM-399)

This memorandum deals with a proposal by the authors to utilize the very high energy particles in space ($E > 10^{12}$ ev/nucleon) to perform superhigh energy physics experiments on satellites. The various cosmic ray high energy interaction programs are briefly reviewed and the advantage of using satellites is discussed. The status of high energy physics is discussed with respect to current theoretical structure and present and future accelerators. Author

N68-14586# Kansas Univ., Lawrence. Nuclear Physics Lab.
NUCLEAR STRUCTURE LABORATORY Progress Report, Aug. 1, 1966–Jul. 31, 1967
Sep. 1967 67 p refs
(Contract AT(11-1)-1120)
(COO-1120-68) CFSTI: HC $3.00/MF $0.65

Nuclear reaction data are presented on several facets of laboratory research. These pertain to collective effects in $P^{31}(He^3,p)S^{33}$ reaction; proton capture reactions in C^{14}; gamma ray transitions in Be^7 following proton capture in Li^6; the $S^{32}(p,\gamma)Cl^{33}$ reaction; and the transfer reactions in scattering of complex nuclei. Angular correlation measurements using Doppler-broadened gamma ray transitions are discussed, along with the use of IBM 1800 data acquisition and control system. M.G.J.

N68-14590# Brookhaven National Lab., Upton, N. Y.
HIGH ENERGY SCATTERING FROM NUCLEI
C. Wilkin Aug. 1967 77 p refs Presented at the C.A.P. Summer School McGill Univ., Montreal, 14–18 Aug. 1967 Sponsored by AEC
(BNL-11722) CFSTI: HC $3.00/MF $0.65

A lecture is given on the theory of small-angle elastic scattering of high-energy nucleons on light-weight nuclei and also on inelastic scattering in which low-lying states are excited. A review is also given of high-energy electron scattering. NSA

N68-14591# Joint Inst. for Nuclear Research, Dubna (USSR).
DECAY OF ^{170}Lu [RASPAO ^{170}Lu]
N. A. Bonch-Osmolovskaya, Ya. Vrzal, E. P. Girgor'ev, N. G. Zaitseva, Ya. Liptak et al 1967 29 p refs In RUSSIAN
(JINR-P6-3452)

The γ-ray spectra from ^{170}Lu decay was measured and the ^{170}Lu decay scheme constructed and analyzed. Author (NSA)

N68-14592# Stanford Univ., Calif. Linear Accelerator Center.
EFFECT OF AN EXTERNAL RF SOURCE ON THE STABILITY OF THE CURRENT PULSE IN A LINEAR ACCELERATOR
V. A. Vishnyakov, A. I. Zykov, I. A. Grishaev, and V. M. Grizhko Sep. 1967 7 p refs Transl. into ENGLISH of Akad. Nauk URSR, Kharkov, Fiz.-Tekhn. Inst. Rept. No. 306/VE-069
(SLAC-TRANS-75; Rept.-306/VE-069) CFSTI: HC $3.00/MF $0.65

An investigation is made of the effect of an external high-frequency oscillation source on the shortening of the current pulse in a linear accelerator. It is shown that at a more than 10^{-8}W power level current pulse shortening begins with lower threshold current values. The dependence of pulse shortening on the generator frequency is investigated. Author (NSA)

N68-14597# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
ON THE DECAY MODE OF ^{158}Er [O SKHEME RASPADA ^{158}Er]
A. A. Abdurazakov, K. Ya. Gromov, Zh. T. Zhelev, V. G. Kalinnikov, Ya. Liptak et al 1967 13 p refs In RUSSIAN Submitted for publication
(JINR-P6-3496)

Gamma-ray and conversion electron spectra, and β^+-decay of ^{158}Er were investigated. New γ-transitions of 270, 294.1, and 341.6 keV were observed. New levels of energies 160.3(2^-), 408.9 keV(1^+), and 425.6 keV(1^-) were introduced into the decay mode of ^{158}Er. The multipolarities of transitions were determined to be 386.9, 358.3, and 341.6 keV. The multipolarities of some other γ-transitions are estimated. Quantum characteristics of 67.2 keV (2^-) and 454.2 keV(1^-) levels are determined. The mass difference of ^{158}Er and ^{158}Ho nuclei is found to be (1860±60 keV). The decay mode of ^{158}Er is discussed. Author (NSA)

N68-14598# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ONE-PARTICLE STATES OF DEFORMED NONAXIAL NUCLEI
F. A. Gareev, L. I. Vinokurov, and B. N. Kalinkin 1967 22 p refs
(JINR-E4-3453)

A method for calculating the one-particle neutron and proton states of nonaxial deformed nuclei is suggested. The average nucleus field is assumed to be described by a finite potential with a diffuse edge. The results may be used for the study of the equilibrium shape of nuclei. Author (NSA)

N68-14664# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
COMPARATIVE REVIEW OF TWO-DIMENSIONAL KINETICS METHODS
K. F. Hansen 18 Aug. 1967 46 p refs
(Contract AT(04-3)-167)
(GA-8169) CFSTI: HC $3.00/MF $0.65

Methods of solution for two-dimensional, multigroup, reactor kinetics problems are reviewed. Based upon the analysis of computing requirements, and the properties of the existing

UNIVAC-1108 computer equipment at General Atomic, recommendations are made with respect to what methods should be pursued to develop a production code. Some suggestions are also made regarding areas of further methods development. The methods which are reviewed include the following: Explicit Integration, WIGL2 Method, GAKIN Method, ADI Methods, VARI-QUIR Method, and GRCORK Method. The results of the study indicate that a practical 2-D kinetics code for the existing UNIVAC-1108 is possible. The most favorable method of solution is probably the ADI with the GRCORK and GAKIN approaches less attractive, but still potentially useful. Author (NSA)

N68-14665# California Univ., Berkeley. Lawrence Radiation Lab.
NUCLEAR DOUBLE RESONANCE DYNAMICS
David Alexander McArthur (Ph.D. Thesis) Jul. 1967 242 p refs
(Contract W-7405-ENG-48)
(UCRL-17468) CFSTI: HC$3.00/MF$0.65

A quantitative detailed study of the validity of the master equation with spin temperature assumption is used to describe the nuclear double resonance detection of a rare spin species. The technique of nuclear double resonance following adiabatic demagnetization of ^{19}F nuclei in the rotating frame (ADRF) has been used to study the resonance of 0.13% abundant ^{43}Ca in CaF_2. Radio frequency (rf) pulses were applied near the ^{43}Ca Larmor frequency after ADRF, and a study of cross-relaxation between ^{19}F dipolar energy and ^{43}Ca Zeeman energy in the rotating-frame effective field H_{eB} measured the ^{19}F dipolar spectrum in CaF_2 for this kind of transition. The measured cross-relaxation rate decreases exponentially with increasing H_{eB} at $\theta = 90°$, 60°, 45°, and 30°, and is proportional to $\sin^2\theta$ where θ is the angle between the laboratory magnetic field, H_0, and H_{eB}. A thermal-reservoir model of the cross-relaxation process, assuming slowly-varying spin temperatures for both the ^{19}F and ^{43}Ca nuclei, and assuming infinitely fast spin diffusion among ^{19}F nuclei, agrees with experiment at all values of θ, if a five-to-ten-degree misorientation of the crystal with respect to $\bar{H}_0$ is postulated. Audio saturation double resonance measurements of cross-relaxation rates yielded results in agreement with the pulsed experiments. Pulsed experiments showed no evidence of a finite ^{19}F spin diffusion rate. Author (NSA)

N68-14666# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie.
DETERMINATION OF SOME EXCITATION FUNCTIONS FOR DEUTERON REACTIONS WITH ^{141}Pr [BESTIMMUNG EINIGER ANREGUNGSFUNKTIONEN FUER DEUTERONEN-REAKTIONEN MIT Pr-141]
Juergen Lange Feb. 1967 75 p refs In GERMAN
(KFK-519)

The (d,p), (d,2n), and (d,3n) effective cross sections for ^{141}Pr were determined using the internal beam of an isochronous cyclotron. A rarely used monitor method in which target and monitor substances were homogeneously mixed with each other was used for current measurement. The absolute effective cross sections were measured, and the pattern of the excitation functions for the nuclear reactions considered were determined and were qualitatively evaluated. An error evaluation was made, and results for the mixed monitor method were compared with the usual monitor methods. The yield for the irradiation of thick-targets was calculated using the excitation function. Using the activities produced for the determination of the effective cross sections, an accurate half-life determination was also made for ^{141}Pr. A previously unknown ground state of ^{139}Nd was found, and some decay data were determined for it. For deuteron energies under the range of application of the monitor reaction, effective cross-section ratios were measured for the (d,2n) and (d,p) reactions. Author (NSA)

N68-14680# European Nuclear Energy Agency, Paris (France).
[HELIUM-3 NEUTRON–PROTON AND NEUTRON–DEUTERON REACTION AND SCATTERING CROSS SECTIONS]
Sep. 1967 32 p refs /ts Newsletter No. 6
(CCDN-NW-6)

A compilation of existing data on the $^3He(n,p)T$ and the $^3He(n,d)D$ reaction cross sections and the total and scattering cross sections is presented. It is shown that a proper extrapolation of the thermal (n,p) cross section fits the data above 5 keV. A table of evaluated recommended values of the $^3He(n,p)T$ cross section up to 10 MeV is given. The estimated uncertainties of recommended values are 0.2% (1 eV), 1% (1 keV), 3% (10 keV), and 10% (>100 keV). The $^3He(n,d)D$ cross section is deduced from the inverse reaction, and the proper detailed balance formulas for the differential and total reaction cross sections are discussed. Author (NSA)

N68-14682# Illinois Univ., Urbana. Dept. of Physics.
CROSS SECTIONS FOR π^+, π^-, K^+ AND K^- MESONS ON COMPLEX NUCLEI
William Verne Hassenzahl (Ph.D. Thesis) Aug. 1967 141 p refs
(Contract AT(11-1)-1195)
(COO-1195-99) CFSTI: HC$3.00/MF$0.65

A measurement of the absorption and diffraction cross sections of 3.5-GeV/c π and K mesons on beryllium, carbon, aluminum, copper and lead was made. A set of circular scintillation counters measured transmission as a function of angle for each element. Cross sections were then calculated from the observed transmissions. Absorption and diffraction cross sections are given for 3.5 GeV/c π^+, π^-, K^+ and K^- on beryllium, carbon and aluminum, for π^+, π^- and K^+ for copper, and for π^+ and π^- on lead. The diffraction cross sections are found to be larger than the values predicted by optical model calculations. This is discussed in terms of the relative magnitudes of the real and imaginary parts of the nuclear potential. Author (NSA)

N68-14688# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
MEASUREMENT OF β^+-p-COINCIDENCES FOR Te^{111} DELAYED PROTON EMITTER [IZMERENIE β^+-p-SOVPADENII DLYA IZLUCHATELYA ZAPAZDYVANYUSHCHIKH PROTONOV Te^{111}]
I. Bacho, D. D. Bogdanov, S. Daroczy, V. A. Karnaukhov, and L. A. Petrov 1967 17 p refs In RUSSIAN Submitted for publication
(JINR-P6-3494)

Delayed protons of ^{111}Te ($T_{1/2}$=19.5 sec) which is produced by the reaction $^{102}Pd(^{12}C,3n)$ were studied. The proton spectra were measured simultaneously in coincidence with positrons and without coincidences. These spectra essentially differ since the coincidences single out only the positron branch of the ^{111}Te decay. The intensity ratio in these two spectra is determined by the probability ratio of positron decay and K-capture of ^{111}Te into the proton-unstable states of ^{111}Sb. The measured ratios of the proton intensities were compared with the calculated ratios. From the condition of the best fit the value $Q_0-\beta_p=5.07 \pm 0.07$ MeV is obtained, where Q_0 is the energy of K-capture of ^{111}Te and B_p the binding energy of a proton in ^{111}Sb. This value is in the best agreement with the calculations made using the Zeldes' and Garvey-Kelson's formulas. Author (NSA)

N68-14689# Argonne National Lab., Ill.
MECHANISM OF TWO BODY INTERACTION AT HIGH ENERGIES [MECHANISMES DE L'INTERACTION A DEUX CORPS A HAUTE ENERGIE]

P. Sonderegger May 1967 25 p refs Transl. into ENGLISH from J. Phys. (Paris), v. 27, 1966 p 11-22 Presented at the Colloq. on Fundamental Particles, Dyon, France, 22 Jun. 1966
(ANL-TRANS-497) CFSTI: HC$3.00/MF$0.65

The discovery of quasi-elastic processes of the diffractive type with a region of momentum that is independent of the energy, and the clarification of the mechanism of the exchange process produced by experimental confirmations of the Regge pole model are considered. The importance that is attached to the rate of dependence on energy of the momentum regions, integrated as well as differential, in the transfer of fixed pulsing is emphasized. NSA

N68-14709# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
MANY-PARTICLE INTERACTIONS AT HIGH AND SUPERHIGH ENERGIES [MNOGOCHASTICHNYE VZAIMODEISTVIYA V OBLASTI VYSOKIKH I SVERKHVYSOKIKH ENERGII]
I. Z. Artykov, V. S. Barashenkov, and S. M. Eliseev 1967 7 p refs In RUSSIAN
(JINR-P2-3508)

Using the Monte-Carlo method the nucleon–nucleus interactions are analyzed at energies higher than 100 GeV. The characteristics of many-particle interactions are determined. Author (NSA)

N68-14710# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
PL BLACKNESS THEORY IN PLANE GEOMETRY
S. P. Congoon and M. R. Mendelson 1967 36 p refs Presented at the Am. Nucl. Soc. Winter Meeting, Chicago, 4–8 Nov. 1967
(Contract W-31-109-ENG-52)
(KAPL-P-3391; CONF-671102-28) CFSTI: HC$3.00/MF$0.65

The derivation of blackness boundary conditions is reviewed and is generalized into a standard matrix formalism that is valid for P_L approximations of any order. It is then shown that effective diffusion and absorption matrices which can reproduce blackness boundary conditions at the interfaces can be found. The effective matrices are evaluated explicitly for the case of the P_3 approximation. The results of numerical calculations for a model problem consisting of a black slab in an infinite scattering medium with a uniform source are presented. Equivalent diffusion and absorption matrices for the finite mesh point description of the black region are given explicitly for the cases of two and three mesh points. NSA

N68-14716# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
THE LIMIT OF APPLICABILITY OF THE WEAK FOUR-FERMION INTERACTION THEORY [O PREDELE PRIMENIMOSTI TEORII SLABOGO CHETYREKHFERMIONNOGO VZAIMODEISTVIYA]
E. P. Shabalin 1966 11 p refs In RUSSIAN and ENGLISH
(ITEF-471)

The ratio of the vector constants of β- and μ-decay with consideration of radiational corrections for weak interaction is used to find the value of the limiting momentum up to which the weak interaction theory is valid. Using three different schemes of that theory (the Gell-Mann–Feynman theory modified by the requirement of muon charge conservation, the Cabibbo hypothesis, and CP-odd weak interaction) values of 490, 270, and 440 GeV respectively are obtained. NSA

N68-14717# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
INVESTIGATION OF KINETIC EQUATIONS FOR MODELS WITH EXCITED STATES [ISSLEDOVANIE KINETICHESKOGO URAVNENIYA DLYA MODELI S VOZBUZHDENNYM UROVNEM]
A. V. Shelest 1967 10 p refs In RUSSIAN; ENGLISH summary
(ITF-67-11)

The irreversible character of the kinetic equation is studied. The entropy is shown, in the general case, to grow with increasing time. A solution of the kinetic equation is obtained for the model of a fermion with an excited level. It is shown that in the asymptotic case ($t \to \infty$) the density matrix of the system tends to its equilibrium value. Author (NSA)

N68-14718# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
HIGHER ORBITAL STATES IN THE FRAMEWORK OF SYMMETRY THEORY
V. G. Kadyshevskii and R. M. Moradyan 1967 26 p refs
(ITF-67-10)

The symmetry group SU(24) appearing in the Greenberg model (Phys. Rev. Lett., 13: 592(1964) and relating to the group SU(6), $SU(3)_L$, O(3), etc. is studied by a reduction scheme. NSA

N68-14719# Sandia Corp., Albuquerque, N. Mex.
TWO-CENTER PROBLEM OF QUANTUM MECHANICS. 3. TERM TABLES
L. I. Ponomarev and T. P. Puzynina [1967] 65 p Transl. of Joint Inst. for Nucl. Res. Rept. no. JINR-P4-3175
(SC-T-0953; JINR-P4-3175) CFSTI: HC$3.00/MF$0.65

The tables are listed which present the results of calculations for some terms of the two-center problem of quantum mechanics which were obtained by the method suggested in the previous papers. Author (NSA)

N68-14720# California Univ., Berkeley. Lawrence Radiation Lab.
A COMPARATIVE STUDY OF (P,T) AND (P,^{3}HE) REACTIONS ON LIGHT NUCLEI
Donald George Fleming (Ph.D. Thesis) Aug. 1967 151 p refs
(Contract W-7405-ENG-48)
(UCRL-17790) CFSTI: HC$3.00/MF$0.65

The (p,t) and (p,^{3}He) reactions on ^{15}N and ^{13}C targets were investigated. Transitions to mirror final states in the mass-13 and mass-11 final nuclei were studied over 15 and 12.5 MeV of excitation, respectively. Several spin and parity assignments are made. In particular, the lowest lp-shell T = 3/2 states in these nuclei were identified. The DWBA predictions of the angular distributions arising from these (p,t) and (p,^{3}He) transitions were generally found to reproduce the experimental data well. For the ^{15}N(p,t)^{13}N and ^{15}N(p,^{3}He)^{13}C reactions, these calculations were carried out using intermediate-coupling wave functions to describe the final state; for the ^{13}C(p,t)^{11}C and ^{13}C(p,^{3}He)^{11}B reactions, pure jj configurations were assumed. In addition to giving a good account of the observed angular distributions, the DWBA calculations of relative cross sections for the (p,t) transitions were also found to be in good agreement with experiment. Comparative measurements of these (p,t) and (p,^{3}He) reactions populating mirror final states was used to test some of the assumptions made in current theories of direct two-nucleon transfer reactions. The

agreement in cross section ratios of mirror (p,t) to (p, ^{3}He) transitions is found to improve in every case with the inclusion of a strongly spin-dependent force in the nucleon–nucleon interaction, but overall satisfactory agreement is not obtained. The (p,t) transitions are found to be generally stronger than expected relative to their mirror (p, ^{3}He) transitions, and three cases are discussed where the experimental ratios of these cross sections exceed the theoretical upper limit. Interference terms arising either through the spin-orbit interaction in the optical potential or through a core-excitation mechanism are suggested as accounting for this result. Author (NSA)

N68-14728# Lyon Univ. (France).
STUDY OF THE REACTIONS (n,α) ON ^{32}S AND ^{40}Ca [ETUDE DES REACTIONS (n,α) SUR S^{32} ET Ca^{40}]
Joseph Hajj-Boutros (Ph.D. Thesis) Jul. 1967 96 p refs In FRENCH
(LYCEN-6746)

The PWBA method is reviewed with emphasis on the calculation of transition amplitudes. The geometric part of the problem is considered in some detail. The simple reaction mechanisms of pick-up and knock-out are then analyzed. The theoretical results are applied to the reactions ^{40}Ca(n,α)^{37}Ar and ^{32}S(n,α)^{29}Si. The results obtained are discussed, and the mechanism proposed is critically evaluated. It is concluded that the ^{40}Ca(n,α)^{37}Ar has an angular distribution that can be interpreted by a direct interaction process, a mixture of the pick-up and knock-out mechanisms. The ^{32}S(n,α)^{28}Si reaction can also be interpreted by the same mechanism, but appears more probable to interpret it by the statistical model. NSA

N68-14729# Lyon Univ. (France).
REACTION ^{32}S(n,α)^{29}Si: EXCITATION CURVES FROM 3.25 TO 5.15 MEV AND ANGULAR DISTRIBUTIONS AT 4.1 TO 5.15 MEV [ETUDE DE LA REACTION S^{32}-(N,α$_0$)Si^{29}; COURBE D'EXCITATION DE 3,25 A 5,15 MEV ET DISTRIBUTIONS ANGULAIRES A 4,1 ET 5,15 MEV]
Roland Billerey (Ph.D. Thesis) Jun. 1967 80 p refs In FRENCH
(LYCEN-6741)

The excitation curve from 3.25 to 5.15 MeV and the angular distributions at 4.1 and 5.15 MeV were measured for the reaction ^{32}S(n,α)^{29}Si. A bibliographic review was made of the results obtained elsewhere on this reaction, and the results were compared. The experimental device used in the study is described in detail, and the results are reported. The results show that the limit of utilization of a single detector for the study of this reaction was attained because of the background of the detector itself. The angular distributions attained do not differ greatly from previous results. The formation of a compound nucleus can explain the results especially at E_n = 4 MeV. The direct interaction permits an agreement of the same order but seems to give a more certain distribution at 5.1 MeV. NSA

N68-14734 Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant.
USE OF REACTION GAMMAS FOR ANALYSIS OF IMPURITIES IN ALPHA EMITTERS
J. M. McKibben Nov. 1966 14 p refs Presented at 153d Natl. Meeting of the Am. Chem. Soc., Miami, Fla., 9–14 Apr. 1967
(Contract AT(07-2)-1)
(DPSPU-66-30-12; CONF-670401-12)

With a gamma spectrometer, light element impurities in reaction with alpha particles can be identified by analysis of the resulting radiation—specifically gamma photons, or "reaction gammas." This technique has been successfully used on production lots of $^{238}PuO_2$ from which neutron emission rates were excessively high. At the inception of this work a catalog of possible reactions and their gamma energies was assembled. Because of deficiencies in these data it was necessary to determine experimentally the reaction gamma spectra for a number of light elements. This was done by measuring gamma spectra before and after addition of known quantities of these elements to $^{238}PuO_2$. Although some absolute emission rates of reaction gammas were obtained, this technique is largely qualitative rather than quantitative, because the gamma yield is highly dependent on the incident alpha particle energy and therefore on the homogeneity and purity of the sample. Author

N68-14741# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
COLLECTIVE EFFECTS IN RADIATIVE CAPTURE REACTIONS AND IN NUCLEAR SPECTROSCOPY Progress Report, Jan.–Sep. 1967
Patrick J. Daly Sep. 1967 24 p refs
(Contract AT(11-1)-1672)
(COO-1672-5) CFSTI: HC $3.00/MF $0.65

The energy levels of ^{151}Gd, ^{184}Os, and ^{181}Re were investigated by measuring the energies and relative intensities of γ rays emitted in the decays of ^{151}Tb, ^{184}Ir, and isomeric ^{181}Os, respectively. Level schemes for ^{151}Gd and ^{181}Re were established. The ground-state rotational and γ-vibrational bands of ^{184}Os were identified, and the conversion coefficients for many of the low-energy transitions in ^{151}Gd were estimated. Similar measurements of γ energies and intensities in the decays of ^{195}Ir and 20-hr ^{181}Re were also made. Additionally, excitation functions for the spallation reactions ^{181}Ta(α,xn)$^{185-x}$Re, ^{181}Ta(He-3,xn)$^{184-x}$Re, ^{207}Pb (He-3,xn)$^{210-x}$Po, and ^{208}Pb (He-3,xn)$^{211-x}$Po, where x = 1 through 4, were measured. Notable differences between the curves for the corresponding α and ^{3}He-induced reactions were observed. It was also found that the sum of the (He-3,xn) curves is considerably less than that of (α,xn) curves. Measurements of the excitation functions for some ^{3}He-induced reactions in this mass region indicated that charged-particle emission does not account for the difference between the two total reaction cross sections. NSA

N68-14757# Brookhaven National Lab., Upton, N. Y. Accelerator Dept.
EFFECTS OF SEXTUPOLES NEAR A ONE-THIRD INTEGRAL ν VALUE IN THE AGS: AN EXAMPLE
M. Month 28 Aug. 1967 18 p refs
(BNL-11759; AGSCD-19) CFSTI: HC $3.00/MF $0.65

The theory of sextupole perturbations near a one-third integral ν value in the AGS is tested by comparing results with results of a direct numerical integration of the force equations. The numerical procedure used was developed previously to investigate a slow beam extraction process. NSA

N68-14765# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
COLLECTIVE EXCITATIONS OF EVEN–EVEN ATOMIC NUCLEI [KOLLEKTIVNYE VOZBUZHDENIYA CHETYKH ATOMNYKH YADER]
A. S. Davydov 1967 92 p refs In RUSSIAN; ENGLISH summary
(ITF-67-9)

A review is presented of the principal theoretical investigations of the collective excited states of even–even nuclei. The problem of classification of the excited states in spherical and non-spherical nuclei is studied. Attention is drawn to the phenomenological theory of quadrupole excited states. Different approximations are

investigated for this theory. It is shown how in the phenomenological theory the energies of excited states and the probabilities of electromagnetic transitions between them are expressed in terms of a number of parameters characterizing the nuclear shape in the ground state and its deformability. An outline of the theory of the octupole excited states is given. The connection between the phenomenological theory and a "microtheory" of collective excitations is pointed out. Author (NSA)

N68-14773# Naval Civil Engineering Lab., Port Hueneme, Calif.
ESTIMATING STRENGTHS OF INDIVIDUAL RADIOISOTOPES IN A MULTIPLE ISOTOPE SOURCE Technical Report, Nov. 1964–Mar. 1967
M. L. Eaton and W. L. Wilcoxson Nov. 1967 81 p ref
(NCEL-R-551; AD-662192) CFSTI: HC $3.00/MF $0.65

In work related to radiation shielding, the use of radioisotope techniques, and activation analysis, an experimenter must often analyze counting data where counts are caused by the natural background and by the decay of more than one radioisotope. In the report a procedure is developed for estimating the strength of each isotope at different times from several decaying radioactive samples of a single multiple-isotope source. In addition, the procedure provides a method for placing confidence limits on the strengths and a method for partitioning the imprecision of estimating the strengths into three principal causes: Poisson variation, sampling error, and residual error (called mechanical error). An operational FORTRAN II-D computer program, SAND, implements the procedure. The procedure and program were tested by using fictitious data with known properties as inputs. The results of the simulation were in reasonable agreement with the theoretical values. Author (TAB)

N68-14775# Pomona Coll., Claremont, Calif. Dept. of Physics.
LOW ENERGY X-RAY AND ELECTRON PHYSICS Final Report, 1 Jun. 1964–31 May 1967
Burton L. Henke May 1967 7 p refs
(Grant AF-AFOSR-689-64)
(AFOSR-67-2751; AD-662607)

The research is concerned with a study of the complete interaction of the ultrasoft x-rays with matter in the 10-to-100 A wavelength region and of the associated production of photo and Auger electrons in the 10 to 1000 electron volt energy region. Such a study is important because it is on an area of atomic physics which has been hitherto neglected and because it has important applications to chemical and solid state analysis, microanalysis, high temperature plasma diagnostics, and to x-ray astronomy via rockets and satellites. The specific objectives of this grant period were: (1) The measurement and tabulation of ultrasoft x-ray interaction coefficients. (2) The continued development and refinement of methods for the generation, the detection and the spectroscopy of the low energy x-rays and electrons. (3) The application, independently and collaboratively of the low energy x-ray and electron interaction physics and its associated instrumentation to the chemical and valence band analysis of matter and high temperature plasma analysis through the ultrasoft x-ray spectroscopy of the solar corona. A resume of the results of the research and a list of publications are given. Author (TAB)

N68-14801# California Univ., Davis. Crocker Nuclear Lab.
[EXPERIMENTAL NUCLEAR PHYSICS] Annual Report
John A. Jungerman and William W. True 15 Sep. 1967 46 p refs
(Contract AT(11-1)-GEN-10)
(UCD-CNL-88) CFSTI: HC $3.00/MF $0.65

A review is given of the operating experience for the 76-in. cyclotron at the Crocker Nuclear Laboratory. Data are given for the gamma spectra from $(\alpha,n\gamma)$ reactions on ^{138}Ba and ^{117}Sn at 45 MeV. NSA

N68-14802# Australian National Univ., Canberra. Research School of Physical Sciences.
INELASTIC SCATTERING OF ^{3}He FROM ^{6}Li, ^{7}Li, ^{10}B, ^{19}F, AND Al AT 10 MEV
K. L. Coop, J. M. Poate, and E. W. Titterton [1967] 4 p refs
(ANU-P-385)

The differential cross sections for the inelastic scattering of 10-MeV ^{3}He ions by ^{27}Al, ^{19}F, ^{6}Li, and ^{7}Li at 40° and by ^{10}B at 40, 90, and 140° were measured using semiconductor detectors in the focal planes of either a Buechner mass spectrograph or a 24-in. double-focusing spectrometer to identify the particle groups. NSA

N68-14803# Illinois Univ., Urbana. Dept. of Physics.
MEASUREMENT OF THE TWO-PHOTON DECAY OF THE NEUTRAL KAON MESON
John Andrew Todoroff (Ph.D. Thesis) Aug. 1967 149 p refs
(Contract AT(11-1)-1195)
(COO-1195-100) CFSTI: HC $3.00/MF $0.65

The decay $K_L^0 \rightarrow 2\gamma$ has been observed and the branching ratio has been measured in a spark chamber-counter experiment. A branching ratio roughly consistent with a model for $K_L^0 \rightarrow 2\gamma$ in which the decay proceeds through virtual π^0 and η^0 states was obtained. Shower energies were measured with an average resolution of ±30% with lead-and-scintillator total absorption counters behind each spark chamber. These energies ranged from 0.4 to 1.2 BeV. Stereoscopic pictures were taken of the showers of each event. The two photon energies and angles were compared with the kinetmatics for a $K_L^0 \rightarrow 2\gamma$ decay. The presence of two decay charged particles in coincidence was detected as a count of the sum of all the principal charged modes ($\pi^+e^-\nu$, $\pi^+\mu^-\nu$, $\pi^+\pi^-\pi^0$). Detection efficiencies for each charged and neutral decay mode were calculated by Monte Carlo techniques. Using these efficiencies, together with the total number of charged coincidences and the 32 events identified as $K_L^0 \rightarrow 2\gamma$, a branching ratio, relative to all modes, of $(6.7 \pm 2.2) \times 10^{-4}$ was obtained. Author (NSA)

N68-14805# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
TIME-DEPENDENT NEUTRON TRANSPORT WITH ELASTIC SCATTERING
M. Borysiewicz and J. Mika 1967 16 p refs Transl. into ENGLISH from Polish
(INR-805/21/TH)

The linear integro-differential neutron transport equation for a finite homogeneous body surrounded by a vacuum is considered. The scattering kernel includes the term describing the elastic scattering in isotropic approximation. The spectral properties of the corresponding operator are found, and the initial value problem is solved. Author (NSA)

N68-14813# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
X-REPRESENTATION OF THE NUCLEON–NUCLEON INTERACTION USED IN THE SUPERFLUID NUCLEAR MODEL [KONFIGURATSIONNOE PREDSTABLENIE VZAIMODEISTVIYA NUKLONOV PRIVODYASHCHEGO K SVERKHTEKUCHEI MODELI YADRA]
V. Ryberska 1967 10 p refs In RUSSIAN
(JINR-P4-3505)

The pairing interaction is investigated in the x-representation. The result is, that this interaction is nonlocal both in the case of pairing in the infinite momentum space and pairing between nucleons of the last unfilled nuclear shell. Author (NSA)

N68-14814# Joint Inst. for Nuclear Research, Dubna (USSR).
INVESTIGATION OF THE DECAY OF THE PM FRACTION ISOTOPES [ISSLEDOVANNE RASPADA IZOTOPOV PROMETIEVOI FRAKTSII]
M. P. Avotina, E. P. Grigor'ev, A. V. Zolotavin, V. O. Sergeev, M. I. Sovtsov et al 1967 22 p refs In RUSSIAN
(JINR-P6-3471)

Gamma-ray and internal-conversion electron spectra of the Pm isotopes with A=143, 144, 146, and 148 were investigated by using a semiconductor Ge(Li)-γ-spectrometer and a double-focusing β-spectrometer. A number of new transitions was found and the multipolarities of some transitions are determined. Author (NSA)

N68-14815# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE CALCULATION OF INELASTIC INTERACTIONS OF COSMIC NUCLEI [KRASCHETU NEUPRUGIKH VZAIMODEISTVII KOSMICHESKIKH YADER]
V. S. Barashenkov, K. K. Gudima, and B. D. Toneev 1967 6 p refs In RUSSIAN
(JINR-P2-3507)

The results of cascade calculations of deuteron and α-particle interactions with nuclei at high energies are discussed.
Author (NSA)

N68-14816# Minnesota Univ., Minneapolis. School of Physics.
THEORETICAL PHYSICS PROGRAM Progress Report, 1 Sep. 1966–31 Aug. 1967
Sep. 1967 38 p refs
(Contract AT(11-1)-1371)
(COO-1371-43) CFSTI: HC $3.00/MF $0.65

Theoretical and experimental investigations in high-energy and nuclear physics are briefly described. A list of papers published and soon to be published is also included. NSA

N68-14817# Paris Univ., Orsay (France).
STRONG DECAYS OF BARYONIC RESONANCES 3/2⁻ IN BARYONS AND PSEUDOSCALAR MESONS AND SU(3) SYMMETRY
E. Cremmer Sep. 1967 16 p refs
(LPTHE-TH-214)

The strong decays of $3/2^-$ of baryonic resonances into baryons and pseudoscalar mesons were studied in the framework of SU(3) symmetry. It is shown that the results are in agreement with experiment by using a Lorentz invariant form for the transition matrix element and taking into account the Y_0^*–$Y_0'^*$ mixing.
Author (NSA)

N68-14819# Illinois Univ., Urbana. Dept. of Physics.
A TEST OF TIME REVERSAL INVARIANCE USING THE MOESSBAUER TRANSMISSION OF THE 73 KEV TRANSITION IN Ir^{193}
Muzaffer Atac Nov. 1967 97 p refs
(Contract N00014-67A-0305-0005)
(TR-165; AD-662675)

Real and imaginary part of the E2-M1 mixing ratio of the 73 keV transition in Ir193 were determined in an arrangement that requires no correction for Faraday rotation and isomer shift. The parameters, E-gamma = 73.8 keV, g1/2 = 0.9408, R-delta = 0.556, H = 1.437 MG, and f = 0.5, were determined. The value Im-delta = (+1.0 plus or minus 1.7) x 0.001 results in a phase angle between E2 and M1 of eto = (+1.8 plus or minus 3.0) x 0.001, thus showing no evidence for a T violation. Author (TAB)

N68-14973 European Organization for Nuclear Research, Geneva (Switzerland).
PROCEEDINGS OF THE 1966 CERN SCHOOL OF PHYSICS, VOLUME 3
H. A. Tolhoek, D. H. Miller, and B. D. Hyams 10 Aug. 1967 183 p refs Proc. held at Noordwijk aan Zee, 6–18 Jun., 1966
(CERN-66-29, V. 3)

CONTENTS:

1. STATUS OF FUNDAMENTAL SYMMETRIES AND WEAK INTERACTIONS H. A. Tolhoek (Groningen Rijksuniv.) p 1–92 refs (See N68-14974 05-24)
2. RESONANCES D. H. Miller (Calif. Univ.) p 93–152 refs (See N68-14975 05-24)
3. EXPERIMENTAL POSSIBILITIES WITH PROTON INTERSECTING STORAGE RINGS B. D. Hyams p 153–162 (See N68-14976 05-24)

N68-14974 Groningen Rijksuniversiteit (Netherlands). Instituut voor Theoretische Fysica.
STATUS OF FUNDAMENTAL SYMMETRIES AND WEAK INTERACTIONS
H. A. Tolhoek *In* CERN Proc. of the 1966 CERN School of Phys., Vol. 3 10 Aug. 1967 p 1–92 refs (See N68-14973 05-24)

A concise review is presented on the status of the more classical selection rules of the weak interactions (concerning isospin, ΔS, etc.), and on the problems of universal fermi interaction, lepton-conservation, and intermediate boson hypothesis. Further the invariance or noninvariance of weak interactions for the fundamental P, C and T transformations is examined, including a discussion of PC violation in K_L^0 decay. Author

N68-14975 California Univ., Berkeley. Lawrence Radiation Lab.
RESONANCES
Donald H. Miller *In* CERN Proc. of the 1966 CERN School of Phys., Vol. 3 10 Aug. 1967 p 93–152 refs (See N68-14973 05-24)

Advances in analyzing baryon and meson resonances are discussed, and consideration is given to those areas where knowledge is limited and further experimental and theoretical analyses are necessary. Among the points made are the following: (1) The discovery and classification of states fitting within the framework of SU(3) and Regge recurrences must continue, with clarification of the structure known to exist in the S=+1 systems identified as a major problem. (2) The properties of possible candidates for both the $J^P=0^+$ and 1^+ nonets should be established. A table of known baryons and mesons and their decay properties is presented, and a reference bibliography is included. M.G.J.

N68-14976 European Organization for Nuclear Research, Geneva (Switzerland). Nuclear Physics Div.
EXPERIMENTAL POSSIBILITIES WITH PROTON INTERSECTING STORAGE RINGS
B. D. Hyams *In its* Proc. of the 1966 CERN School of Phys., Vol. 3 10 Aug. 1967 p 153–162 (See N68-14973 05-24)

The basic reasons for building proton intersecting storage rings (ISR) are reviewed, and the basic differences between electron and proton storage rings are compared. The parameters of the ISR are summarized, and the storage ring magnet arrangement design shows that the rings can be filled in a time (5 to 10 minutes) short compared with the beam lifetime (12 hours before the reaction rate drops by a factor of 2). Very efficient use of the ISR is

considered possible if it is limited to about 10% of the proton synchrotron protons. Fields of investigation are cited as p–p elastic scattering, quasi-elastic scattering (two-body final states), and inelastic processes. A reference bibliography on colliding beam experiments is included. M.G.J.

N68-14979 European Organization for Nuclear Research, Geneva (Switzerland). Synchro-Cyclotron Machine Div.
RADIOACTIVITY INDUCED IN BUILDING MATERIALS
M. Barbier 15 Sep. 1967 39 p refs
(CERN-67-25)

Activation of structural materials, irradiation experiments, and measurements of natural radioactivity of building materials are described. It was determined that specific radiation fields for thermal, epithermal, and fast neutrons varied widely from target to target. The results for activation by high energy particles producing spallations were grouped around 10^{-14} rad/h per gram at 1 meter, except for calcium. Samples of building materials were irradiated in a pure 600 MeV proton beam, in a mixed neutral flux in the vicinity of the synchrocyclotron, and in a mixed charged and neutral flux near the proton synchrotron's target. The results of these experiments are extensively graphed. It was found that calcite is one-third as active as concrete or silica, and about one-tenth as active as aluminum. Carbon was found to be usually better than calcite. Pure white marble is considered to have the best natural radioactivity for low-level laboratories. N.E.N.

N68-14983# Oak Ridge National Lab., Tenn.
CALCULATIONS, USING THE ALBEDO CONCEPT, OF THERMAL–NEUTRON FLUXES, EPICADMIUM–NEUTRON FLUXES, AND FAST-NEUTRON DOSE RATES ALONG THE CENTER LINES OF SQUARE CONCRETE DUCTS: COMPARISON WITH EXPERIMENT
R. E. Maerker and F. J. Muckenthaler Oct. 1967 75 p refs
Sponsored in part by DASA
(Contract W-7405-ENG-26)
(ORNL-4147) CFSTI: HC$3.00/MF$0.65

Monte Carlo calculations that use the albedo concept and a particularly demanding source geometry and spectrum were carried out to determine subcadmium- and epicadmium-neutron fluxes and fast-neutron dose rates along the center lines of one-, two-, and three-legged square concrete ducts open on the source end. Secondary gamma-ray dose rates arising from the capture of neutrons in the duct walls were also calculated. A comparison of the calculated neutron fluxes and dose rates with those obtained in geometrically identical experiments shows agreement generally within 25% through five orders of duct attenuation. The results thus place on a firm foundation the method of treating neutron transmission through large-sized ducts as a multiple-reflection phenomenon describable by the differential albedo properties of the walls. The conclusion is also reached that wall-capture gamma-ray dose rates arising from capture of thermal neutrons and the dose from the thermal neutrons themselves can comprise a very important part of the total absorbed dose rate in tissue at locations deep inside a multilegged duct. Author (NSA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-13917# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Gas Ionizzati.
PHOTO-COUNTING AS A TECHNIQUE FOR DETERMINING CORRELATIONS IN A PLASMA
B. Crosignani (Istituto Superiore di Sanita), P. Di Porto (Istituto Superiore di Sanita), and F. Engelmann Apr. 1967 23 p refs
(LGI-67/8) CFSTI: HC$3.00/MF$0.65

Counting photons scattered from a single-mode laser beam passing through a plasma may be used for determining correlations in the plasma. Higher-order moments of the distribution of photon counts are related to an ensemble average of higher-order products of the electric field. This method also yields information about higher-order correlations of the electron density fluctuations, in contrast with the measurement of the scattering cross section that depends only on second-order correlations. The connection between the statistics of photon counts and the properties of electron density fluctuations was presented concentrating on the first and second moment of the photon count distribution. The incident wave was assumed to be plane and ideally monochromatic. For stable plasmas in a steady state, the results are written in terms of the distribution functions of the electron and ion velocities. Weakly turbulent unstable plasma in the phase of exponential growth was also considered, using as a characteristic parameter the spectrum of the electric microfield. Author (ESRO)

N68-13921# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
ELECTRIC FIELDS IN SPACE. A SURVEY
Carl-Gunne Faelthammar Oct. 1967 27 p refs
(Rept.-67-23) CFSTI: HC$3.00/MF$0.65

Surveys the electric fields in space and points out further theoretical and observational investigations needed to improve the knowledge in this important field of research. Although some of the electric fields in space have a terrestrial origin (induction due to ionospheric winds and rotation of the earth) the most important of them are of extraterrestrial origin, their ultimate cause being the motion of the magnetized interplanetary plasma (solar wind) and its interaction with the magnetic field of the earth (the magnetosphere). Author (ESRO)

N68-13924 Wissenschaftliche Gesellschaft fuer Luft- und Raumfahrt, Brunswick (West Germany).
REPORT ON COMBINED MEETINGS OF THE WGLR TECHNICAL COMMITTEES ON ENERGY CONVERTERS AND ELECTRIC MOTORS AND PLASMA FLUX [BERICHT UEBER DIE GEMEINSAMEN SITZUNGEN DER WGLR-FACHAUSSCHUESSE ENERGIEWANDLER UND ELEKTRISCHE ANTRIEBE UND PLASMASTROEMUNGEN]
Oct. 1967 174 p refs In GERMAN Meetings held in Stuttgart, 22 Jan. 1965 and 1 Apr. 1966
(DLR-Mitt.-67-17)

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11. HEAT TRANSFER OF ARGON AND NITROGEN PLASMA ON A COLD WALL T. Bose p 147–157 refs (See N68-13935 05-25)

12. PHENOMENOLOGY OF PLASMA ENGINE CATHODES AT HIGH CURRENT RATES AND LOW PRESSURES H. Huegel and G. Kruelle p 158–165 (See N68-13936 05-25)

N68-13925 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Aachen (West Germany). Institut fuer Theoretische Gasdynamik.

NONSTATIONARY STAGNATION POINT FLOW IN MAGNETO GAS DYNAMICS [INSTATIONAERE STAUPUNKTSTROEMUNG IN DER MAGNETOGASDYNAMIK]

I. Teipel *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Combined Meetings of the WGLR Tech. Comm. on Energy Converters and Elec. Motors and Plasma Flux Oct. 1967 p 7–24 refs Sponsored by Ohio State Univ. (See N68-13924 05-25)

Interactions between external magnetic fields and the ionized hypersonic gas flow past a reentry body are analyzed by obtaining the stagnation point flow velocity. Magnetohydrodynamic equations are formed that contain the proper Maxwellian equations and Ohm's law for an electrically conducting viscous fluid in the presence of a magnetic field. Results show that external magnetic field effects delay the laminar boundary layer separation from the hypersonic body. Transl. by G.G.

N68-13926 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Plasmadynamik.

ARC DISCHARGE IN SUPERSONIC FLOWS [LICHTBOGENENTLADUNGEN IN UEBERSCHALLSTROEMUNGEN]

H. Huegel, S. Krause, and Th. Peters *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Combined Meetings of the WGLR Tech. Comm. on Energy Converters and Elec. Motors and Plasma Flux Oct. 1967 p 25–37 (See N68-13924 05-25)

Shape and stability of arc discharges in supersonic gas flows were studied experimentally. Vertical discharge in a supersonic plasma flow did not stabilize without the presence of a transverse magnetic field. A stabilized axial arc discharge was obtained at 4 mm Hg pressure and at a current of 360 A in an argon plasma. Arc discharge propulsion studies for ramjet engine models established the feasibility of arc discharge propulsion at subsonic velocities. Arc discharges into a self accelerating plasma also remained stable when plasma flow remained at supersonic velocity. Transl. by G.G.

N68-13927 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Energiewandlung und Elektrische Antriebe.

EXPERIMENTAL STUDIES OF AN ELECTRODELESS PLASMA ACCELERATOR WITH A CONICAL DISCHARGE COIL [EXPERIMENTELLE UNTERSUCHUNGEN IN EINEM ELEKTRODENLOSEN PLASMABESCHLEUNIGUNGSSYSTEM MIT KONISCHER ENTLADUNGSSPULE]

M. M. Savary *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Combined Meetings of the WGLR Tech. Comm. on Energy Converters and Elec. Motors and Plasma Flux Oct. 1967 p 38–49 refs (See N68-13924 05-25)

Reported are velocity measurements along the acceleration path of an electrodeless plasma acceleration system with conical discharge coil; a gas filled tube as well as a pulsed entrance phase are evaluated. Photomultiplier analyses show that the axial magnetic field increased plasma torus acceleration in the axial direction; an even higher acceleration is obtained for the pulsed phase where a smaller gas volume is accelerated through the vacuum. Plasma velocity correlated to the distance of discharge coil spacing. Theoretical evaluation of the photomultiplier registered reactions confirmed an acceleration increase for magnetically driven shock waves. Transl. by G.G.

N68-13928 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Energiewandlung und Elektrische Antriebe.

SPECTROSCOPIC MEASUREMENTS OF AN ELECTRODELESS PLASMA ACCELERATOR [SPEKTROSKOPISCHE MESSUNGEN AN EINEM ELEKTRODENLOSEN PLASMABESCHLEUNIGER]

R. Koehne *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Combined Meetings of the WGLR Tech. Comm. on Energy Converters and Elec. Motors and Plasma Flux Oct. 1967 p 50–71 refs (See N68-13924 05-25)

Time integrated spectra of an electrodeless helium plasma accelerator were evaluated for electron temperature and emission intensity. An emission energy of 0.2 J (about 0.3°/oo) was obtained by a 750 J energy plasma pulse at 2 Torr gas pressure. An electron temperature of 33,000°K was calculated from CII and CIII lines at a pressure of 0.05 Torr and a conductivity of 150 $(\Omega m)^{-1}$ was obtained for the approximated electron density of about 1.5×10^{13} cm^{-3}. Transl. by G.G.

N68-13929 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Plasma Dynamik.

STUDY OF PLASMA ENGINES WITH THERMAL AND MAGNETIC ACCELERATION [UNTERSUCHUNGEN AN PLASMATRIEBWERKENMIT THERMISCHER UND MAGNETISCHER BESCHLEUNIGUNG]

H. Huegel, G. Kruelle, and Th. Peters *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Combined Meetings of the WGLR Tech. Comm. on Energy Converters and Elec. Motors and Plasma Flux Oct. 1967 p 72–83 refs (See N68-13924 05-25)

Axisymmetric plasma engine models were evaluated for their preformance characteristics under thermal or electromagnetic acceleration. Thermal arc discharge processes were accentuated with additional heating of the acceleration path into the lower pressure regimes, increased acceleration effects were also obtained by using the anode as terminal for the lamellar nozzle thus producing electromagnetic forces through the magnetic field of the flow. Transl. by G.G.

N68-13930 Technische Hochschule Munchen (West Germany). Elektrophysikalisches Institut.

STUDY OF A SUPERSONIC PLASMA BEAM WITH AN AXIAL FLOW [UNTERSUCHUNGEN AN EINEM UEBERSCHALLPLASMASTRAHL MIT AXIALEM STROM]

K. Ragaller *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Combined Meetings of the WGLR Tech. Comm. on Energy Converters and Elec. Motors and Plasma Flux Oct. 1967 p 84–94 refs (See N68-13924 05-25)

Axial flow of a high current through a supersonic plasma jet increases its velocity and energy. Quantitative measurements of nozzle exit pressure, Mach number at nozzle exit, and pressure distribution in the jet axis as well as theoretical analyses establish

that: (1) Pressure increases at the nozzle exit with increased current flow as the Mach number shows an initial decrease; (2) magnetic effects dampen the stationary pressure waves in the free jet below 500 A; (3) theoretical and experimental results verify the pressure dependency of the periodic jet transformation to a non-periodic mode; and (4) a non-periodic jet is also observed at very high nozzle exit and external pressure ratios. Transl. by G.G.

N68-13931 Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

ON MEASURING A MAGNETIC FIELD-STABILIZED HIGH TEMPERATURE ARC [UEBER MESSUNGEN AN EINEM MAGNETFIELDSTABILISIERTEN HOCHTEMPERATURBOGEN]

K. Bergstedt, P. Grassmann, O. Klueber, and H. Wulff *In* Wiss. Ges. fuer Luft- und Ramfahrt Rept. on Combined Meetings of the WGLR Tech. Comm. on Energy Converters and Elec. Motors and Plasma Flux Oct. 1967 p 95–104 (See N68-13924 05-25)

A rotating mirror camera with an interference filter that only processes the 4686 Å line of the H-ion is used to analyze the high temperature arc discharge in a gas filled tube with external magnetic driver coil. Only that part of the plasma is observed that corresponds to sufficient high temperatures for exciting this line, (about 55,00°K). Line and continuum intensities of the observed spectra are then evaluated by using the Saha equation to obtain an equilibrium for the double charged ions and the free electrons; the Faraday effect is used to measure the electron density. Results show that a magnetic field-stabilized high temperature arc does not produce a sufficiently high compression for stationary plasma production. Transl. by G.G.

N68-13932# Technische Hochschule Munchen (West Germany). Institut fuer Thermodynamik der Luft- und Raumfahrt.

USE OF INCIDENT WEDGE IN SUPERSONIC PLASMA FLOW FOR DIAGNOSTIC EVENTUALITIES [ANGESTELLTER KEIL IM PLASMAUEBERSCHALLSTRAHL ALS DIAGNOSTIZIERUNGSMOEGLICHKEIT]

W. Haug, K. F. Knoche, and S. Krause (Deut. Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart) *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Combined Meetings of the WGLR Tech. Comm. on Energy Converters and Elec. Motors and Plasma Flux Oct. 1967 p 105–116 refs (See N68-13924 05-25)

The geometry of a shock wave front, formed during impingement of a plasma jet on a wedge, was measured interferometrically and used to evaluate the thermodynamic characteristics of the plasma flow. Theoretical and experimental studies with an argon plasma jet showed that the plasma jet had a temperature of about 4000°K at thermodynamic equilibrium, and a temperature of about 7000°K in the nonequilibrium state. Transl. by G.G.

N68-13933 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Plasmadynamik.

MEASURING OF A SUPERSONIC PLASMA FLOW WITH AERODYNAMIC PROBES [MESSUNGEN MIT AERODYNAMISCHEN SONDEN AN EINEM UEBERSCHALL-PLASMASTRAHL]

S. Krause *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Combined Meetings of the WGLR Tech. Comm. on Energy Converters and Elec. Motors and Plasma Flux Oct. 1967 p 117–132 (See N68-13924 05-25)

Dynamic pressure, mass flow, and enthalpy sensors were used to measure the thermodynamic characteristics of a supersonic argon plasma jet with emphasis on the relationship between velocity and gas temperature. Integrated mass and energy flux measurements for the complete jet cross section of a 140 A plasma flow were compared to measured values 2.5 resp. 55 mm from the exit and showed a 26.9% decrease in energy flux at the last measuring point; for a 70 A plasma jet, about 31.4% of the energy flux remained at 55 mm distance from the nozzle exit. Transl. by G.G.

N68-13934 Technische Hochschule Aachen (West Germany).

THE ELECTRIC ARC WITH RADIAL MASS INJECTION [ZUR THEORIE DES ELEKTRISCHEN LICHTBOGENS MIT RADIALER MASSENEINSTROEMUNG]

H. Druxes, H. J. Patt, and G. Schmitz *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Combined Meetings of the WGLR Tech. Comm. on Energy Converters and Elec. Motors and Plasma Flux Oct. 1967 p 133–146 refs (See N68-13924 05-25)

Electric arc geometries and environmental effects are studied for plasma flows of high temperature and high enthalpy. Thermodynamic effects on the tube wall material during radial gas flux can be reduced by introducing the gas through the arc, by pinching the arc nucleus, and by transferring the introduced electric energy almost completely to the gas enthalpy. Maximal axial temperature for such a discharge arc is much higher and produces the same thermal wall effects than similar arcs without radial gas flow introduction. Transl. by G.G.

N68-13935 Technische Hochschule Stuttgart (West Germany). Institut fuer Thermodynamik der Luft- und Raumfahrt.

HEAT TRANSFER OF ARGON AND NITROGEN PLASMA ON A COLD WALL [DER WAERMEUEBERGANG VON ARGON- UND STICKSTOFF-PLASMA AN EINE KALTE WAND]

T. Bose *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Combined Meetings of the WGLR Tech. Comm. on Energy Converters and Elec. Motors and Plasma Flux Oct. 1967 p 147–157 refs (See N68-13924 05-25)

Variable boundary layer equations were used to calculate the heat transfer from an argon equilibrium plasma to surrounding solid cold walls. Assumed was a stationary Hagen–Poiseuille flow without outer boundaries where the heat transfer from the hot gas to the cold walls uses internal gas energy. Results for an argon plasma flow between two parallel plates established conductive heat transfer as $0.01 m^2$/sec for a flow velocity of 10 m/s and an initial plasma temperature of 16000°K; for a longitudinal plasma flow over flat plates, a heat transfer of about 4 kW/cm^2 was found for a flow velocity of 10 m/s and a plasma temperature of 15000°K. Transl. by G.G.

N68-13936 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Plasmadynamik.

PHENOMENOLOGY OF PLASMA ENGINE CATHODES AT HIGH CURRENT RATES AND LOW PRESSURES [PHAENOMENOLOGIE VON PLASMATRIEBWERKSKATHODEN BEI HOHEN STROEMEN UND NIEDRIGEN DRUECKEN]

H. Huegel and G. Kruelle *In* Wiss. Ges. fuer Luft- und Raumfahrt Rept. on Combined Meetings of the WGLR Tech. Comm. on Energy Converters and Elec. Motors and Plasma Flux Oct. 1967 p 158–165 (See N68-13924 05-25)

The effects of low surrounding pressures on cathodes of arc jet engines with electromagnetic acceleration are investigated for pressure and current energies of 20 to 100 Torr, and 400 to 1000 A. Experiments with a 50 mm long and 8 mm diameter tungsten–thorium cathode in a coaxial gas flow show that pre-heating of the cathode reduces the duration of the instable arc discharge and thus material loss. The use of lighter gases also reduces instability effects, as well as the use of increased pressures and a massive gas influx. Transl. by G.G.

N68-14030# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Gas Ionizzati.

DERIVATION OF LANDAU DAMPING USING THE 'BUCKETS' IN PHASE SPACE

J. G. Linhart Mar. 1967 13 p refs
(LGI-67/5) CFSTI: HC $3.00/MF $0.65

The existence of damping of longitudinal plasma oscillations was discovered by Landau. It is shown that the phenomenon of Laundau damping can be analyzed and understood using concepts of linear particle accelerators. ESRO

N68-14032# European Space Research Institute, Frascati (Italy).
ON THE SIMILARITY LAWS FOR THE INTERACTION OF THE SOLAR WIND WITH THE MAGNETOSPHERE
K. Schindler Paris ESRO Dec. 1966 23 p refs
(ESRO-SN-16) CFSTI: HC $3.00/MF $0.65

The problem of simulating space phenomena in the laboratory requires a detailed discussion of the similarity laws involved. The set of similarity laws to be used depends on the parameter regime and on the degree of approximation chosen. It turns out that even a qualitative simulation of the full terrella problem is extremely difficult to achieve. It seems possible, however, to investigate special problems separately. The MHD flow around a dipole and the structure of the collision-free shock wave are discussed from this point of view. It seems possible to simulate these phenomena in the laboratory. Author (ESRO)

N68-14078*# Catholic Univ. of America, Washington, D. C.
MAGNETOHYDRODYNAMIC FLOWS OVER A ROTATING DISK
Hsien-ping Pao Washington NASA Jan. 1968 25 p refs
(Grant NsG-586)
(NASA-CR-989) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The flow of an incompressible viscous electrically conducting fluid over a rotating disk is investigated. In addition, a circular magnetic field is also imposed at the disk. One physical interest in this flow lies in the possibility of using such a magnetic field to shield a rotating body from excessive heating. Similarity assumptions lead to a reduction of the governing equations to a set of ordinary differential equations. These are integrated numerically. Some approximate solutions are also obtained. The role of the magnetic field here is to thicken the flow boundary layer and to reduce the strength of the axial flow field. That means, the magnetic field has a diffusing and stiffening effect upon the flow field. As a consequence, the frictional moment at the disk is reduced. For sufficiently large values of the applied magnetic field, the boundary layer separates from the surface of the disk. Author

N68-14138 Lockheed Missiles and Space Co., Sunnyvale, Calif.
INVESTIGATION OF THE SPATIAL DISTRIBUTION OF THE PLASMA DENSITY BY REFRACTION OF A MICROWAVE RAY WITH SEVERAL FREQUENCY COMPONENTS
L. A. Dushin, V. I. Konowenko, and A. I. Sbibenko 1967 9 p refs Transl. into ENGLISH from the book "High Frequency Properties of Plasma" Kiev, Naukova Dumka, 1967 p 107–117

Described are experiments which show that the method of determining the spatial density distribution by means of refraction of microwave rays at different frequencies may successfully be applied to investigate plasma in both the stationary and pulse modes. In the first case, to find the dependences $\lambda(\omega)$ and $\theta(\omega)$ it is necessary to select the position of the receivers for each frequency at which the refracted signal has the maximum value. In the second case, the signals are supplied at arbitrarily selected distances of angles and the dependence $\lambda(\tau)$ or $\theta(\phi)$ is constructed for each value of ω. From the time dependencies $\lambda(\omega)$ or $\theta(\omega)$ are established for certain times. The measurements simplify considerably if there are sources of several frequencies or a system of entrances and exits of several frequencies. The distribution may hence be found at a single discharge. Author

N68-14179# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Gas Ionizzati.
PLASMAS IRRADIATED IN A MAGNETIC FIELD, PART 1
A. Cavaliere, P. Guipponi, and R. Gratton Jun. 1967 13 p refs
(LGI-67/11) CFSTI: HC $3.00/MF $0.65

Plasmas produced by irradiating a solid particle with a laser beam expand isotropically while being heated by the radiation, and if restrained only by their own inertia, rather soon become transparent. Only very short radiation pulses are effectively absorbed; the resulting plasmas have highly transient properties at high densities, whereas at low densities their expansion energy is well in excess to the thermal energy. A magnetic field can transform part of the expansion energy back again into thermal energy, furthermore, if it can balance the total stress of the plasma at an early stage of the expansion, it may conceivably enhance the absorption through the modification of the plasma dynamics. It is shown that the considered magnetic field configuration subetantially affects the absorption through the modifications of the dynamics, so that small amounts of plasma can be given energy densities in the range of several 10^{21} eV/cm^3 using 1 GW laser pulse for many tens of nanoseconds without stringent requirements for the rise time; moreover, the plasma can be kept in a reasonably steady state during times appreciably longer than the irradiation time. ESRO

N68-14251# Los Alamos Scientific Lab., N. Mex.
ELECTRON-OPTICAL METHOD OF RECORDING THOMSON SCATTERING OF LIGHT OF A RUBY LASER BY A PLASMA
G. G. Dolgov-Savel'ev, A. M. Iskol'dskii, E. P. Krugliakov, and V. K. Malinovskii 1967 10 p refs Transl. into ENGLISH from Russian Preprint
(LA-TR-67-77) CFSTI: HC $3.00/MF $0.65

Preliminary experiments are described in which a simultaneous measurement of local instantaneous values of n_e and T_e was conducted. NSA

N68-14334# University of Southern Calif., Los Angeles. Dept. of Physics.
ARC PLASMA DIAGNOSTICS WITH VACUUM ULTRAVIOLET RADIATION Final Scientific Report, 1 Feb. 1965–30 Jun. 1967
Gerhard L. Weissler Wright-Patterson AFB, Ohio ARL Aug. 1967 22 p refs
(Contract AF 33(615)-2395)
(ARL-67-0178; AD-662626)

The purpose of this investigation was to study the emission and absorption properties in the vacuum ultraviolet region of the spectrum, between 200A and 2000A, of thermally stabilized cascade arcs. These arcs were operated at about 100 amp and 60 V in either argon, neon or helium at roughly one-third of an atmosphere of pressure. Rapid differential pumping was required at either end of the arc in order to allow vacuum ultraviolet radiation to pass from the arc into a 2 m radius of curvature grazing incidence grating vacuum spectrograph, or alternately to transmit through the arc plasma radiation from a separate light source. Emission and absorption work was limited to feasibility studies because of the long lead-time in establishing an operating plasma arc. These studies proved highly promising, both with respect to vacuum UV emission from the arc and transmission through the arc. Author (TAB)

N68-14413# Miami Univ., Coral Gables, Fla. Dept. of Physics.
INSTABILITIES AND TURBULENCE IN ALKALI VAPOR PLASMAS Progress Report, 1 Nov. 1966–31 Oct. 1967
Harry S. Robertson 31 Oct. 1967 12 p refs
(Contract AT(40-1)-2454)
(ORO-2454-9) CFSTI: HC $3.00/MF $0.65

Progress is described in the experimental and theoretical study of helical instabilities in minimum-B and uniform axial field

geometry in a cesium arc plasma, experimental and theoretical studies of electrodeless rf-excited plasmas in magnetic fields, a general study of plasma diffusion as a boundary value problem, and a theoretical study of the diffusion of magnetized plasma filaments as a model for plasma turbulent diffusion. A reprint of the first publication on filamentary diffusion is attached. Author (NSA)

N68-14420# Stanford Univ., Calif. Inst. for Plasma Research.
STUDIES OF PLASMA OSCILLATIONS Status Report No. 30, Mar. 1-Jul. 30, 1967
F. W. Crawford Sep. 1967 41 p refs
(Contract AT(04-3)-326)
(SU-IPR-198) CFSTI: HC $3.00/MF $0.65

Research in the following areas is discussed: ion wave propagation and positive column instabilities, Langmuir probes in collisional plasma, cyclotron echoes, pulse technique for determination of collisional data, cyclotron harmonic wave phenomena, and beam/plasma interactions. NSA

N68-14472*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EXPERIMENTAL STUDIES IN MAGNETOFLUID DYNAMICS: PIPE FLOW THROUGH A SOLENOID OF FINITE LENGTH
T. Maxworthy 15 Dec. 1967 24 p refs
(Contract NAS7-100)
(NASA-CR-91773; JPL-TR-32-1198) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A liquid sodium tunnel has been designed and built to study aligned field magneto-fluid-dynamic (MFD) flows. Its major features and the nature of the flow in the test section are described. In particular, it is found that an exit disturbance, created as the liquid conductors leaves the region of magnetic field, can propagate into the test section and affect the flow there. However, only under the most adverse conditions, i.e., very high magnetic fields and low flow velocities, does this impair the usefulness of the tunnel as a device for the accurate measurement of MFD flows. Author

N68-14545# Atomic Energy Commission Research Establishment, Riso (Denmark). Physics Dept.
THE EFFECT OF THE FINITE ION LARMOR RADIUS ON THE KELVIN-HELMHOLTZ INSTABILITY
Henning Melchior and M. Popovic Jul. 1967 13 p refs
(RISO-158)

Excitation of the Kelvin-Holmholtz instability has been observed in a Q-machine when a sufficiently large velocity shear exists between adjacent layers of the plasma column. In an interpretation of this observation, possible effects of the finite ion Larmor radius and the collisional viscosity have been neglected. It is attempted to remove the first of these simplifications. With the finite ion Larmor radius included, the growth rate of the instability is computed for several values of the velocity shear and different e-folding lengths of the density profiles. Author (NSA)

N68-14559*# North Carolina State Coll., Raleigh.
ANALYSIS OF MPD ARCS WITH NONEQUILIBRIUM IONIZATION
R. K. Seals, Jr. and H. A. Hassan 24 Jan. 1968 8 p refs Presented at AIAA 6th Aerospace Sci. Meeting, New York, 22-24 Jan. 1968
(Grant NGR-34-002-048)
(NASA-CR-91685; AIAA Paper-68-87) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A quasi one-dimensional analysis of the MPD arc which takes into consideration finite reate processes and allows for a variable area is presented. Starting from low subsonic velocities at the entrance, the governing equations are integrated through the transonic region into the supersonic region for an argon propellent at low mass flow rates. The results show that the electron temperature is well predicted by the theory; however, calculated velocities are roughly half the measured values. The current densities peak in the neighborhood of the cathode tip and they do not exhibit any unusual features in the transonic region. Author

N68-14685# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
THE MECHANISM CAUSING HEAT DRIVEN PRESSURE OSCILLATORS IN A GAS-THERMOACOUSTIC GENERATOR DESIGN Final Report
K. T. Feldman, Jr. Sep. 1967 30 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.
(Contract AT(29-1)-789)
(SC-CR-67-2759) CFSTI: HC $3.00/MF $0.65

The operating principles and governing equations for the thermoacoustic phenomenon are reviewed, and an example of the design of a typical thermoacoustic generator is presented. Various geometries of the Sondhauss generator are reviewed as a possible plasma driver for an alternating-current magnetohydrodynamic generator. NSA

N68-14746# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany).
OPTIMIZATION OF THE MHD-GENERATOR USING A LIQUID METAL AS A WORKING MEDIUM [DIE OPTIMIERUNG DES MIT EINEM FLUESSIGEN METALL BETRIEBENEN MHD-GENERATORS]
N. Kayukawa Nov. 1967 27 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-71; DVL-683)

The optimization of a direct current and of an electrodeless induction type of MHD-power-generator, which are operated by using an incompressible fluid as a working medium is examined by employing the method of variational calculus for the total electrical power. The solutions of Euler's equations are the spatial constancy of the pressure for a d.c. MHD-generator and the spatial constancy of the flow velocity of an a.c. MHD-generator respectively. This performance of the fluid flow, that is the construction of the channel geometry, gives a physically attainable maximum efficiency. Author

N68-14767# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
NUMERICAL INVESTIGATION OF COLLISIONLESS COMPRESSION OF A PLASMA WITH ANOMALOUS FRICTION
R. Chodura Oct. 1967 28 p refs
(IPP-1/72)

The effect of friction on the time development of the profile of a strong compression pulse propagating perpendicular to a magnetic field is studied in cylindrical geometry using two-fluid equations. The friction term roughly describes the action of a two-stream instability by limiting the electron velocity to a critical value. Depending on this critical value and a parameter δ (ratio of electron inertial skin depth to initial plasma radius), the steepening process during compression may or may not lead to a discontinuity. The time history of the profiles and conditions for the occurrence of the discontinuity are investigated for the case that no magnetic field is initially present in the plasma. Author

N68-14772# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPEED DISTRIBUTION OF LIQUID METAL IN AN ANNULAR CHANNEL OF RECTANGULAR SECTION [RASPREDELENIYE SKOROSTI ZHIDKOGO METALLA V KOL'TSEVOM KANALE PRYAMOUGOL'NOGO SECHENIYA]

V. I. Mezhburd 18 Aug. 1967 18 p refs Transl. into ENGLISH from Tr. Po Politekhnicheskiy Inst. (Tallinn), Ser. A, No. 214, 1964 p 43–53
(FTD-HT-66-526; AD-662249)

A fundamental equation of magnetic hydrodynamics was solved for one turn of a helical rectangular-cross-section channel having finite axial and radial dimensions; the channel sides are commensurable. The problem was solved under certain simplifying assumptions and only for a stationary laminar flow of the liquid metal. The very complicated formulas for local and average velocities of the liquid metal and for the electromagnetic pressure cover all varieties of d-c pumps. By imposing limit conditions, it is possible to obtain from the above formulas the equations developed by other authors for ring channels with infinite axial width of the turn, for flat channels with finite cross-section, and also for a narrow slot. TAB

N68-14789# Naval Weapons Lab., Dahlgren, Va.
ELECTRICAL PROPERTIES OF RADIO FREQUENCY GLOW DISCHARGES IN AIR AT ATMOSPHERIC PRESSURE
H. A. Schwab Nov. 1967 59 p refs
(NWL-2124; AD-662397)

Gas discharges maintained by radio frequency power were examined in the frequency range 1-25 Mc/s. The discharges were maintained in air at atmospheric pressure between water cooled metal electrodes. The discharges were made symmetric by using two electrodes alike in shape and material. Important discharge quantities such as the voltage necessary to maintain the discharge, current density, and dissipated power were measured. The minimum instantaneous value of voltage necessary to maintain a discharge was found to be 270 volts. The current density is largely independent of current and has a value of 30 amps/sq cm (determined by using the peak discharge current). A minimum power of 4 watts is necessary to maintain a discharge. The influence of current amplitude, frequency, electrode distance, and other parameters on discharge voltage and current density was examined. Both voltage and current density were found to be essentially independent of frequency in the frequency range considered. Furthermore it was found that a number of properties of the type of discharge described in this report are analogous to the corresponding properties of dc glow discharges. Author (TAB)

N68-14821# Texas Univ., Austin.
INVESTIGATIONS OF ANOMALOUS DIFFUSION IN LINEAR E-TYPE RF DISCHARGES Final Report
E. J. Powers 23 Aug. 1967 7 p refs
(Contract AT(40-1)-3516)
(ORO-3516-2) CFSTI: HC $3.00/MF $0.65

An investigation was made of enhanced plasma transport across a static magnetic field in an E-type, rf discharge. It is observed experimentally that once the magnetic field exceeds a certain critical value, the rate at which plasma is transported across the field is well in excess of that predicted by classical diffusion theory. A preliminary instability calculation was made. The results indicate that ion-acoustic instabilities may be responsible for the anomalous diffusion. NSA

N68-14908# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
INVESTIGATIONS AT A MODIFIED DUOPLASMATRON ION SOURCE WITH ELECTRON OSCILLATION IN AN ANODE PLASMA [UNTERSUCHUNGEN AN EINER MODIFIZIERTEN DUOPLASMATRON-IONENQUELLE MIT ELEKTRONENOSZILLATION IM ANODENPLASMA]
Peter Ulbricht Oct. 1967 17 p refs In GERMAN; ENGLISH summary
(IPP-2/64)

The special properties of the high-intensity source are a large plasma sheath with small positive space charge forces and a hydrogen neutral gas density in the anode plasma of 1.8×10^{14} cm^{-3} corresponding to $p=5\times10^{-3}$ torr. The source works in continuous operation with a discharge current of about 2 A and provides an emission current of $I_e>200$ mA. In spite of an emission hole with a diameter of 5.5 mm the neutral gas pressure in the extraction gap remains about 1×10^{-5} torr. High field gradients can therefore be used. The emission current density, beam density distribution, and divergence of the extracted ion beam were measured as a function of the ion source parameters. Author

N68-14971# Sandia Corp., Albuquerque, N. Mex.
ELECTROSTATIC ACCELERATION OF PLASMA ELECTRONS AND IONS IN TRANSVERSE MAGNETIC FIELDS
John R. Banister and Everet H. Beckner Oct. 1967 31 p refs
(Contract AT(29-1)-789)
(SC-RR-67-703) CFSTI: HC $3.00/MF $0.65

The theoretical behavior of plasma electrons and ions in the presence of transverse electric and magnetic fields has been examined for two cases. A complete description for all interesting electron densities has been derived for the case in which both the electric field and magnetic induction are constant. For the case of a constant electric field and a magnetic induction which increases linearly with time, the electron and ion behavior has been specified for only rarefied or dense plasmas. In both cases, the plasma was considered to be initially cold and collisionless. The importance of collisions on the findings was examined separately. The results show that the electron energy is strongly dependent on the electron density and that the average electron energy increases as the plasma density increases. The results also indicate that only an insignificant amount of momentum is imparted to the plasma in the direction of the applied electric field. Author

N68-15005 Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany).
KINETIC EQUATIONS FOR MICROSCOPIC PLASMA TURBULENCE
D. Pfirsch, K. Elsaesser, and D. Biskamp Oct. 1967 34 p refs
(MPI-PAE/PL-4/67)

Two types of kinetic equations for the homogeneous microscopic turbulence of a one dimensional plasma are compared with each other. These are the usual quasilinear approach and a theory based on the Hamilton–Jacobi formalism. Both theories should yield the same results as long as particle trapping can be neglected. For small compared times the two theories agree, whereas for times of the order of the Hamilton–Jacobi approach results deviate from the quasilinear theory in a way which can be interpreted as a relaxation effect. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-14051# Forsuarets Forskningsanstalt, Stockholm (Sweden).
SUPERCONDUCTIVITY AT ROOM TEMPERATURE [SUPRALEDNING VID RUMSTEMPERATUR]
B. Johansson Jul. 1967 22 p refs In SWEDISH; ENGLISH summary
(FOA-4-4306-61)

The original research on superconductivity is summed up. The theory by Bardeen, Cooper, and Schrieffer is briefly described.

Some applications of theories on superconductivity and the design of superconducting materials are discussed. The organic superconductory by Little, the surface superconductor by Ginsburg, and the Geilikman superconductor are mentioned. NSA

N68-14055# Darthmouth Coll., Hanover, N. H.
COLOR CENTERS, ENERGY STORAGE, AND THERMOLUMINESCENCE IN LiF CRYSTALS Three-Year Summary Report, Jan. 1965–Jan. 1968
R. W. Cristy and N. M. Johnson 1 Oct. 1967 3 p refs
(Contract AT(30-1)-3474)
(NYO-3474-4) CFSTI: HC$3.00/MF$0.65

The goal of this study as originally stated was to understand the defect-chemical basis of the high-temperature thermoluminescence in dosimetry-grade lithium fluoride. A very brief summary of the results obtained from Jan. 1965 to Jan. 1968 is presented. NSA

N68-14191* Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
THEORY OF THE THERMAL CONDUCTIVITY OF METALS WITH CRYSTAL STRUCTURE DEFECTS [K TEORII TEPLOPROVODNOSTI METALLOV S DEFEKTAMI KRISTALLICHESKOY RESHETKI]
A. M. Wermolayev Washington NASA Dec. 1967 9 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 23, no. 5, 1967 p 813–818
(Contract NASw-1692)
(NASA-TT-F-11418) CFSTI: $3.00 CSCL 20L

We have studied the electron thermal conductivity of a non-ideal metal, taking into account the arbitrary change and amplitude of electron scattering on a specific ion and the deformation of the phonon spectrum under the influence of impurities. We have shown that in the low temperature ranges this leads to a deviation from the Wiedemann–Franz law, the character of which is determined by the values describing the interaction of electrons with impurities as well as by the the parameters of the alloys. Author

N68-14201# Los Alamos Scientific Lab., N. Mex.
LATTICE DYNAMICS OF LITHIUM HYDRIDE
Larry J. Verble (Ph.D. Thesis—Tulane Univ.) 24 Oct. 1967 99 p refs
(Contract W-7405-ENG-36)
(LA-3750) CFSTI: HC$3.00/MF$0.65

Crystalline lithium hydride has the simplest electronic configuration of all ionic crystals with the sodium chloride-type structure. Lattice vibrations in this system have been studied by measuring the phonon dispersion curves along the three high-symmetry directions in a single crystal of ^{7}LiD, using the techniques of coherent inelastic scattering of thermal neutrons. All measurements were taken at room temperature using a triple-axis neutron spectrometer operating in the constant $\vec{Q}$ mode. The transverse zone center frequency is in excellent agreement with the infrared absorption data. The experimental dispersion curves have been least-squares fitted to several versions of the point ion and shell models of lattice dynamics. From the best-fit model, the dispersion curves of ^{7}LiH have been calculated assuming that the forces are identical to those for ^{7}LiD. To simplify the application of the various models and to aid in classifying the dispersion curve branches, group theory has been applied to the problem of lattice vibrations in the sodium chloride structure. Author (NSA)

N68-14337# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
MATHEMATICAL FORMULATION OF THE SCATTERING OF LONG WAVELENGTH NEUTRONS BY DEFECTS IN SOLIDS
D. G. Martin Jul. 1967 44 p refs
(AERE-R-5479) CFSTI: HC$3.00/MF$0.65

The basic equations relating to the scattering of long wavelength neutrons by defects are derived from first principles and results quoted which will be useful in a wide variety of experiments. Differential and total cross sections of both single crystals and polycrystalline material are considered and results for interstitials, vacancies, and impurity atoms in the form of both point defects and clusters are given. Both elements and compounds are considered; also the effect due to the neighbouring lattice atoms around defects being relaxed is discussed. Modifications to these results due to the following effects are considered: (a) defects which are also paramagnetic, (b) solids which, to a certain extent, scatter incoherently, and (c) the effect of lattice vibrations. Author (NSA)

N68-14408# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
THE INFLUENCE OF VARIATION OF THE FORCE CONSTANTS ON THE PROPERTIES OF CRYSTALS WITH IMPURITY ATOMS [K VLIYANIYU IZMENENIYA SILOVYKH POSTOYANNYKH NA SVOISTVA KRISTALLOV S PRIMESNYMI ATOMAMI]
A. P. Zhernov and G. R. Augst 1966 22 p refs In RUSSIAN
(IAE-1280)

An impure crystal theory is constructed with consideration of variation of the force constants. The investigation was conducted on the example of a simple cubic lattice with interaction of nearest neighbors. Simple expressions are presented for the local states, demonstrating directly that with sudden weakening of the force constants a quasi-local state can arise even for a light atom, and with sudden intensification, a local state even for a very heavy atom. Conditions also were obtained under which an admixture atom preferentially fluctuates in those states. It was found that the temperature course of the impurity part of the heat capacity undergoes substantial variations upon sudden variation of the force constants and therefore can serve as a criteron of the magnitude of that variation. Analytical results showed that the temperature course of the probability of Moessbauer effect on the impurity nucleus also is such a criterion. NSA

N68-14414# Marquette Univ., Milwaukee, Wis. College of Engineering.
THE DEFECT STRUCTURE OF NONSTOICHIOMETRIC CeO_{2-x}
R. N. Blumenthal and J. E. Laubach 24 Jul. 1967 19 p refs Presented at the Symp. on Anisotropy in Single-Crystal Refractory Compds., Dayton, Ohio
(Contract AT(11-1)-1441)
(COO-1441-4; CONF-670637-1) CFSTI: HC$3.00/MF$0.65

The electrical conductivity of pressed and sintered specimens of CeO_{2-x} was measured at 800 to 1500°C and at 1 to 10^{-17} atm of oxygen. Based on the excellent fit observed between the theoretically derived relation $\sigma^3 = (A\sigma + B)P^{-1/2}$ and the experimental conductivity data at 1000 to 1500°C, in the higher and intermediate oxygen pressure region, the nonstoichiometric defect structure of CeO_{2-x} was interpreted in terms of a defect model involving quasi-free electrons and both singly and doubly ionized oxygen vacancies. The standard enthalpy of formation for selected defect reactions in CeO_{2-x} was determined. At the lowest oxygen pressures at a200 to 1500°C the electrical conductivity of CeO_{2-x} appears to be relatively insensitive to oxygen pressure. In this region CeO_{2-x} exhibits a large departure from stoichiometry and thus may behave as a degenerate semiconductor. Author (NSA)

N68-14455# British Columbia Univ., Vancouver.
QUANTIZATION AND FLUCTUATIONS IN SUPERCONDUCTORS

Ronald E. Burgess *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 16 p (See N68-14447 05-23)

A thin round hollow cylinder, a superconducting ring with a Josephson junction, and a dc-biased Josephson junction are considered in a discussion of quantization and fluctuations in superconductors. Methods for calculating thermodynamic fluctuations are outlined for each case, and the possibility of using simple equivalent circuits for first order evaluation is indicated. The techniques used appear to be equally applicable to superfluid helium for calculating fluctuations of flow and vorticity. M.W.R.

N68-14457# Bell Telephone Labs., Inc., Murray Hill, N. J.
QUANTUM GENERATION AND DETECTION OF PHONONS IN SUPERCONDUCTORS
A. H. Dayem *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 1 p refs (See N68-14447 05-23)

Two identical Sn–Sn^{0}_{2}–Sn tunnel diodes evaporated on opposite ends of a sapphire single crystal are used for the quantum generation and detection of phonons in superconductors. The first diode, or generator, excites the quasi-particles by tunneling; and, after relaxation, recombination, and generation of phonons, detection is made by the second diode or receiver. M.W.R.

N68-14458# Pennsylvania Univ., Philadelphia.
ON THE USE OF THE AC JOSEPHSON EFFECT TO MAINTAIN STANDARDS OF ELECTROMOTIVE FORCE
Barry N. Taylor (RCA, Princeton, N. J.), William H. Parker, and D. N. Langenberg *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 1 p refs Prepared jointly with RCA, Princeton, N. J. (See N68-14447 05-23)

Microwave induced constant-voltage current steps that arise from the ac Josephson effect in tunnel junctions and point contacts are shown to be usable for checking the constancy of reference standards of electromotive force at the one ppm level for long periods of time. M.W.R.

N68-14464# Massachusetts Inst. of Tech., Cambridge.
MEASUREMENT OF THE ANISOTROPIC ENERGY GAP IN NIOBIUM SINGLE CRYSTALS BY TUNNELING
M. L. A. MacVicar and R. M. Rose *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 6 p (See N68-14447 05-23)

Tunneling characteristics at 1.9°K are reported for single crystals of niobium with resistivity ratio of almost 800 and orientation of approximately (100). Additional experiments are being carried out at 0.9°K with crystals of (11), (112), and (100) direction. Low values of gaps are being observed in the (100) orientation; and gap values along the (110) and (111) orientation are almost equal. Gaps range from 3.1 to 2.9 millivolts, with an anisotropy on the order of 6%. Steps to fabricate junctions are shown, and indium stripes are being used. Of the 15 junctions in which tunneling occurred, four exhibit I–V characteristics with a strange knee structure which was easily reproduced. M.W.R.

N68-14468# Aeronutronic, Newport Beach, Calif. Scientific Lab.
MODULATED FLUX FLOW IN SUPERCONDUCTING FILMS
James E. Mercereau *In* Va. Univ. Proc. of the Symp. on the Phys. of Superconducting Devices Aug. 1967 7 p ref (See N68-14447 05-23)

An ac version of Giaever's transformer was constructed, and a simple model that is essentially a quantized Faraday induction law is used to explain transformer operation in relation to modulated flux flow in superconducting films. Actually, a transformer with a completely superconducting secondary is considered; and an attempt is made to analyze the situation when the flux enclosed by the superconducting secondary is forced to change. It is concluded that the transformer is really a magnetometer based on the principle that the superconducting ring is acting as a flux value and that the minimum size of the flux that the value can allow to pass is h/2e. M.W.R.

N68-14497* National Aeronautics and Space Administration, Washington, D. C.
THEORY OF ABSORPTION OF ULTRASOUND BY FREE ELECTRONS IN METALS IN A QUANTIZED MAGNETIC FIELD. PART 2: PROPAGATION OF SOUND ALONG THE MAGNETIC FIELD [TEORIYA POGLOSHCHENIYA UL'TRAZVUKA SVOBODNYMI ELEKTRONAMI METALLA V KVANTUYUSHCHEM. MAGNITOM. POLE 2: RASPROSTRANENIYE ZVUKA VDOL MAGNITNOGO POLYA]
B. N. Filippov and P. S. Zyryanov Jan. 1968 13 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 24, no. 1, 1967 p 18–26
(NASA-TT-F-11455) CFSTI: $3.00 CSCL 20L

The absorption of circularly polarized waves propagating along a quantized magnetic field and the influence of Landau diamagnetism on the absorption of these waves is studied. The oscillations of the coefficient of absorption are determined for circularly polarized waves with low and with high quantum numbers of the Landau oscillator. It is shown that with low n and finite relaxation times, the amplitude may be great. With high n, the oscillating component is small and dependent on the wave vector of the sonic wave and the magnitude of the external magnetic field. The absorption of ultrasonic P-waves is studied in consideration of electron diffusion. Diffusion is important in estimates of the coefficient of absorption of P-waves at the minimums with small n. With large n, diffusion is always important. Author

N68-14504# Aerospace Corp., El Segundo, Calif. Lab. Operations.
RANDOM WALK MODELS OF PHOTOEMISSION
Steven W. Duckett Oct. 1967 21 p refs
(Contract F04695-67-C-0158)
(TR-0158(3230-13)-1; SAMSO-TR-67-66; AD-662605)

An exact solution in closed form is given for the photoyield in the isotropic random walk model of photoemission. The proof makes use of a theorem of importance in the theory of queues and ladder point variables. The effect of reflection of the photoelectrons at the interface is also treated. A recursion relation for the probability of emission on the nth step P sub n is derived from the expression for the photoyield. Numerical values of the photoyield and the P sub ns are tabulated for numerous values of the relevant parameters, and these numbers are compared with the results of approximate expressions. The exact photoyield values are in good correspondence to a slightly modified version of a formula derived by Kane. A simple approximation is also given for the values of the P sub ns. Author (TAB)

N68-14560 Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Reaktorzentrum.
LOW-ANGLE SUB-GRAIN BOUNDARIES IN TELLURIUM
E. M. Hoerl and J. Weiss 1967 21 p refs Submitted for publication
(SGAE-M-10/1967)

A study of low-angle sub-grain boundaries in tellurium crystals was carried out using electron microscopical techniques. The existence of symmetric tilt boundaries could be proved by the examination of the electron diffraction patterns and the determination of the Burgers vectors forming the boundaries. The motion of the individual dislocations of a boundary at elevated temperatures was investigated and the effect of irradiation with fission fragments studied. Author

N68-14603# California Univ., Berkeley. Lawrence Radiation Lab.
MAGNETIC HYPERFINE FIELD, NUCLEAR G-FACTOR, AND SPIN-LATTICE RELAXATION FOR ^{125}Sb IN IRON FROM NUCLEAR ORIENTATION-NMR
J. A. Barclay, W. D. Brewer, E. Matthias, and D. A. Shirley Aug. 1967 12 p refs Presented at Intern. Conf., Asilomar, Calif., 25–30 Aug. 1967
(Contract W-7405-ENG-48)
(UCRL-17716; CONF-670812-15) CFSTI: HC $3.00/MF $0.65

The method of nuclear orientation nuclear magnetic resonance was applied to the determination of the magnetic hyperfine field, nuclear g-factor, and spin–lattice relaxation time of ^{125}Sb embedded in a lattice of Fe. The sources used in these experiments were prepared by depositing 1 to 2 μC of ^{125}Sb onto Fe foils and melting the samples to obtain solid solutions of less than 1 part Sb in 10^4 parts Fe. NSA

N68-14675# New York Univ., N. Y. Radiation and Solid State Lab.
MECHANISMS OF ENERGY TRANSFER IN DIELECTRICS Semiannual Report, Feb. 1, 1966–Mar. 31, 1967
Hartmut P. Kallmann and Werner Brandt Nov. 1967 50 p refs Sponsored by DASA
(Contract DA-28-043-AMC-01999(E))
(ECOM-01999-2; SAR-2; AD-662714)

A new method - which avoids making measurements or even applying an external voltage while the X-rays are on - was used in performing experiments on the interaction of low intensity X-rays with organic solid insulators (tetracene and anthracene). The following results were obtained: The X-ray induced current is linear with electric field strength over a large range of electric field strength and saturates at field strengths above 10,000 volt/cm; it is proportional to the intensity of irradiation; its magnitude decreases with the thickness of the sample for the same field strength and X-ray intensity, unlike the behavior of normal conduction; 1,600 eV are required to produce one charge pair in anthracene and 400 eV in tetracene. It was also determined that the saturation field strength is independent of the X-ray intensity (it was varied over a factor of ten). A study was made of the time evolution of the energy distribution of the positrons below the ionization threshold in an external electrostatic field, and found: (1) The field induces diffusion out of the Ore gap, which reduces Ps formation. (2) The overall heating effect of the field on the positrons increases Ps formation. Depending on the magnitude of the relevant cross sections, (1) can outweigh (2) at small fields and cause a significant decline in the Ps formation. At field strengths greater than a characteristic value, (2) becomes the dominant effect. In this way measurements of the field dependence of Ps formation can give access, at the energies of the Ore gap, to the cross sections of Ps formation and of positron energy loss and scattering in matter. Author (TAB)

N68-14676# Oklahoma State Univ. Research Foundation, Stillwater.
OPTICAL AND ELECTRICAL PROPERTIES OF STANNIC OXIDE CRYSTALS Final Report, Jun. 1958–Sep. 1967
E. E. Kohnke Nov. 1967 27 p refs
(Contract Nonr-2595(01))
(AD-662692)

A summary is given of research project concerned with the electrical, optical, photoconductive, photoelectric, and thermoelectric properties of natural and artificial stannic oxide crystals. TAB

N68-14700* Florida Univ., Gainesville. Dept. of Metallurgical and Materials Engineering.
A STUDY OF DEFECT STRUCTURES WITH THE FIELD ION MICROSCOPE Semiannual Report, 1 Mar.–31 Aug. 1967
J. J. Hren, R. W. Newman, and R. C. Sanwald 31 Aug. 1967 119 p refs
(Grant NGR-10-005-039)
(NASA-CR-91813; SAR-3) CFSTI: $3.00 CSCL 20L

Two computer models, neighbor model and shell model, have been presented to aid in the interpretation of field ion micrographs of both perfect crystal structures and crystal structures containing defects. The development of the neighbor model, which uses the geometrical environment, or equivalently the atomic binding energy, as an imaging criterion; resulted in point for point agreement with an experimental image. It was shown that variation in intensity on a single plane correlates well with changes in local sublimation energy; however, it appears that additional energy terms are required for intensity variations between planes. The shell model was used to predict defect configurations in field ion images in the FCC, BCC, and HCP systems. Basically all line defects and defect configurations composed to total dislocations could be interpreted in terms of spirals by using the $\vec{g} \cdot \vec{b}$ criterion. Therefore, the important parameter in determining the resulting configuration in the micrograph is the component of the Burgers vector normal to the set of planes on which the dislocation emerges. A field evaporation sequence is usually helpful in determining a unique Burgers vector. Author

N68-14738# Istituto Elettrotecnico Nazionale (Galileo Ferraris), Turin (Italy).
TIME DEPENDENCE OF SPECTRAL COMPONENTS OF THE ELECTROLUMINESCENCE OF ZnS SINGLE CRYSTALS Final Report (Part C)
Guido Bonfiglioli, Piero Brovetto, Gianluigi Busca, and Cesare Cortese Aug. 1967 13 p refs
(Grant AF-EOAR-66-27)
(AFOSR-67-2786; AD-662642)

The paper discusses results of measurements about the time dependence of the monochromatic components of the light emitted by Electroluminescent ZnS single crystals, Cu activated, subjected to a sinusoidal voltage. The light was analyzed with a spectrometer and its time dependance was digitally recorded using a time-to-pulse height conversion technique. The light of two crystals, one (labelled A) exhibiting blue and green EL, the second (labelled B) exhibiting blue, (very weak green) and red EL, was analyzed at 77 degrees K. Both with respect to the exciting voltage and to each other the spectral components of crystals A and B appear nearly in phase, although small time lags, of the order of 0.1 period, different for each component, were actually measured. Between the alternances of the exciting voltage the light does not fall to zero, the relative importance of the continuous light pedestal being different for the various spectral bands. No obvious relationship, however, with the decay times has been found. These results are compared with the few data available from the literature and their relevance as to the mechanism of the EL is briefly discussed. Author (TAB)

N68-14810* Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
THEORY OF ULTRASOUND ABSORPTION BY FREE ELECTRONS IN A METAL IN A QUANTIZING MAGNETIC FIELD. 1 [TEORIYA POGLOSHCHENIYA UL'TRAZVUKA SVOBODNYMI ELEKTRONAMI METALLA V KVANTUYUSHCHEM MAGNITNOM POLE. 1]
B. N. Filippov and P. S. Zyryanov Washington NASA Dec. 1967 22 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 23, no. 5, 1967 p 769–785
(Contract NASw-1692)
(NASA-TT-F-11417) CFSTI: $3.00 CSCL 20L

A systematic theory of ultrasound absorption in a quantizing magnetic field in approximation of relaxation time is constructed. It is shown that the coefficient of absorption is expressed through the conduction current and not through the density of the charge

carrier as has been done by a number of authors. This fact is essential for transverse ultrasound with small values of the quantum number of a Landau oscillator and strong spatial heterogeneities. Quantum oscillations of the coefficient of absorption are studied. It is shown that, in pure form, De Haas–van Alphen type oscillations must exist only in the case of a weak spatial dispersion. If this latter is substantial, then the De Haas–van Alphen oscillations are modulated by oscillations associated with geometric or cyclotron resonance. Author

N68-14876* Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

INDIRECT QUADRUPOLE–QUADRUPOLE INTERACTIONS OF NUCLEI IN METALS [O KOSVENNOM KVADRUPOL'–KVADRUPOL'NOM VZAIMODEYSTVII YADER V METALLAKH]

A. R. Kessel' Washington NASA Dec. 1967 11 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 23, no. 5, 1967 p 837–844

(Contract NASw-1692)

(NASA-TT-F-11420) CFSTI: $3.00 CSCL 20L

We find the operator of indirect quadrupole–quadrupole interactions of nuclei through conduction electrons in metals. We establish a simple relationship between the constant $J_{QQ}^{\perp\perp}$ of this interaction and the time of spin-lattice relaxation of nuclei produced by the electrical quadrupole interactions of nuclei with conduction electrons. We show that the ratio of the constant of the quadrupole–quadrupole exchange to the constant of the spin–spin exchange $J_{\perp\perp}$, computed by Ruderman and Kittel is proportional (with a coefficient of proportionality 36/5) to the ratio of inverse relaxation times, produced by the quadrupole and contact interactions of nuclei with the conduction electrons. Author

N68-14879* Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

THEORY OF THE ENERGY SPECTRUM AND PROPERTIES OF METALS WITH IMPURITIES. 1: MODEL AND GENERAL MATHEMATICAL APPROACH [K TEORII ENERGETICHESKOGO SPEKTRA I SVOYSTV METALLOV S PRIMESYAMI 1: MODEL' I OBSHCHIY MATEMATICHESKIY APPARAT]

O. B. Sokolov and V. Ye. Naysh Washington NASA Dec. 1967 16 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 23, no. 5, 1967 p 819–830

(Contract NASw-1692)

(NASA-TT-F-11419) CFSTI: $3.00 CSCL 20L

Using the mathematical approach of the Green functions we discuss the formulation and analysis of a general solution to the problem of the behavior of an electron system of a metal with impurities in Hartree–Fock approximation. We have obtained equations of self-consistency for matrix elements of the scattering potential in a model of a non-local perturbation introduced by impurity atoms. We give formulas for computing the most important physical characteristics of an impurity metal. Author

N68-14892# Brown Univ., Providence, R. I. Metals Research Lab.

ULTRASONIC STUDIES OF DISLOCATION DYNAMICS AND OF THE DEFORMATION OF SOLIDS Technical Report, Mar. 29, 1966–Jan. 10, 1967

Akira Hikata and Charles Elbaum Wright-Patterson AFB, Ohio AF Mater. Lab. Sep. 1967 43 p refs

(Contract AF 33(657)-8324)

(AFML-TR-67-72; AD-662356)

The report consists of two parts. (1) plastic deformation of gallium single crystals, (2) amplitude dependence of ultrasonic attenuation in lead single crystals. In the case of gallium, it is found that the dislocations do not contribute to the attenuation of ultrasonic waves of 10 Mc/sec or higher frequencies, despite the fact that the gallium crystals undergo plastic deformation with well defined dislocation glide. This phenomenon is quite in contrast to that observed in other metal single crystals such as aluminum, and is tentatively attributed to the large frictional resistance against the high velocity motion of dislocations. In the case of lead, large amplitude-dependent attenuation is observed at low temperatures. At 4.2K, a maximum in attenuation as a function of ultrasonic amplitude is found. From this attenuation maximum, it is possible to reduce the values of the electron contribution to the damping constant and of the interaction force between point defects and dislocations. Author (TAB)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-14346*# Aerojet-General Corp., Sacramento, Calif.

SYSTEM ANALYSIS OF GELLED SPACE STORABLE PROPELLANTS, VOLUME 1 Interim Report, May 1966–Apr. 1967

May 1967 305 p refs

(Contract NAS7-473)

(NASA-CR-91808; Rept.-1083-01IR, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 21I

The objective of this study was to establish the systems aspects of the use of gelled, space-storable propellants in spacecraft engine systems. The four technical tasks of the study are preliminary investigation, preliminary analysis, component design analysis, and system design analysis. The effort was directed toward assessing the potential of this type fluid and identifying the design requirements. The analysis considered passive storability, zero gravity control, expulsion, sloshing, ignition, multiplicity of restarts, propellant utilization, throttlability, performance, heat transfer, and other system design aspects. A summary of the advantages and disadvantages of the use of gelled propellants was prepared for each mission that was studied. Author

N68-14998 Bolkow Entwicklungen K. G., Munich (West Germany).

THEORETICAL RESEARCH ON THE FUEL SPLASH IN SYMMETRICALLY ROTATING ROCKET TANKS IN THE PRESENCE OF ANY INNER LINING [THEORETISCHE UNTERSUCHUNGEN DES TREIBSTOFFSCHWAPPENS IN ROTATIONSYMMETRISCHEN RAKETENBEHAELTERN BEI VORHANDENSEIN VON BELIEBIGEN INNENBERANDUNGEN]

F. Pfeiffer 14 Jul. 1967 31 p refs In GERMAN Presented at DGRR–WGLR Ann. Meeting, Oct. 1967

(FM-372-8)

Finite-difference methods are employed to calculate fuel sloshing modes in propellant tanks of rotational symmetry and with inner linings. Integrated continuity equations are used to describe the small oscillation amplitudes for an incompressible, eddy-free undisturbed flow; the results of the hydrodynamic calculations are then evaluated for the first sloshing mode by mechanical substitution process. Transl. by G.G.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-13998# Societe pour l'Etude et la Realisation d'Engins Balistiques, Courbevoie (France).
APPLICATION OF SOLID PROPELLANT PROPULSION TO THE APOGEE STAGES AND BOOSTERS [APPLICATION DE LA PROPULSION PAR POUDRE AUX ETAGES D'APOGEE ET AUX BOOSTERS ADJOINTS]
L. Melin [1967] 18 p In FRENCH; ENGLISH summary Presented at ELDO Symp. on Propulsion, Paris, 10–12 Oct. 1967 Submitted for publication
(ELDO-SP-67-11) CFSTI: HC $3.00/MF $0.65

Two types of applications for solid propellant engines are considered: Firstly an analysis of the configuration, functioning and performance of solid propellant engines in view of their use for an apogee stage. The development work will have to aim at great accuracy of total impulse and reliability. Secondly, strap-on boosters either as lift-off boosters or as an actual first stage.
Author (ESRO)

N68-14063# Societe d'Etude de la Propulsion par Reaction, Villejuif (France).
THRUST VECTOR CONTROL [CONTROLE D'ORIENTATION DE LA POUSSEE DES MOTEURS-FUSEES]
P. Quevauviller [1967] 17 p In FRENCH; ENGLISH summary Presented at the ELDO Symp. on Propulsion, Paris, 10–12 Oct. 1967 Submitted for publication
CFSTI: HC $3.00/MF $0.65

Describes principles and technology of thrust vector control methods in solid propellant rocket engines either by canted swivelling or gimbaled exhaust nozzles or by secondary injection. Engine characteristics influencing their use are considered.
Author (ESRO)

N68-14067* Hughes Research Labs., Malibu, Calif.
ION ENGINE DEVELOPMENT Final Summary Report
Aug. 1967 364 p refs
(Contract NAS3-6271)
(NASA-CR-54676) CFSTI: $3.00 CSCL 21C

A description of a high thrust density multistrip cesium contact ion engine is presented. Engine operation data to a current density of 25 mA/cm^2 are presented. Three life tests are described during which one engine ran without failure for 953 hours, and two ran without failure for 500 hours. Two of the 500 hour tests were performed at a current density of 20 mA/cm^2. Decel electrodes were utilized on all thruster tests except 42-40-3, -4, -5, and 1334-150-1. Only thruster 2018-150-1 used a neutralizer. Iridium and rhenium coated ionizers were developed and evaluated under this program. Tests indicate that neutral fractions from 1/50 to 1/100 of the value expected from a tungsten surface are likely to be expected from homogeneous iridium or rhenium surfaces.
Author

N68-14112# Hawker Siddeley Dynamics, Ltd., Stevenage (England). Space Div.
ELECTRIC PROPULSION FOR ELDO VEHICLES
R. C. Godwin and T. Rees 1967 32 p refs Presented at the ELDO Symp. on Propulsion, Paris, 10–12 Oct. 1967 Submitted for publication
(ELDO/SP/67-14) CFSTI: HC $3.00/MF $0.65

Reviews the various types of electric propulsion and surveys the possible performances of such systems in relation to ELDO launch vehicles, for the transfer of payloads from parking orbit to synchronous orbit.
Author (ESRO)

N68-14136 Bolkow Entwicklungen K. G., Munich (West Germany).
INTERPLANETARY MISSIONS WITH ELECTRIC PROPULSION [INTERPLANETARE MISSIONEN MIT ELEKTRISCHEN ANTRIEBEN]
Rudolf Metzger [1967] 35 p refs In GERMAN Presented at DGRR Symp. on Interplanetary Aerospace Missions, Munich, 7 Dec. 1967
(FM-386-O; DGRR-67-031)

Electrical and chemical propulsion systems are briefly outlined and optimization analyses for interplanetary mission trajectories with electric spacecraft propulsion are given. Evaluated are space flight trajectories to the outer planetary system as well as a solar probe, and an ecliptic mission for low thrust vehicles.
Transl. by G.G.

N68-14184*# TRW Systems Group, Redondo Beach, Calif. Electric Propulsion Technology Dept.
ION BEAM DIAGNOSTICS AND NEUTRALIZATION Final Report, 14 Feb. 1966–21 Aug. 1967
Robert F. Kemp and David F. Hall 11 Sep. 1967 116 p refs
(Contracts NAS3-7937; AF 33(615)-3195)
(NASA-CR-72343; TRW-06188-6011-R000) CFSTI: HC $3.00/MF $0.65 CSCL 21C

In continuing research on various facets of electric propulsion technology, developmental work was conducted on a mercury discharge neutralizer for potential use in a mercury electron bombardment thruster. Major effort concentrated on maximizing the efficiency with which the neutralizer uses the mercury vapor which flows through it. Conceptual design details are given on a linear strip electric field strength meter which uses the deflection of a free electron current to determine the electric field. The general problem of ground testing an electric thruster is assessed to assure that beam neutralization system performance in space can be accurately predicted. A state of the art review is included on spacecraft diagnostic instrumentation for measuring neutralizer effectiveness and determining the compatibility of electric propulsion systems with scientific payloads. Design considerations for a thrust beam collector for ion engines in the medium power range are discussed, and the design and operation of a frozen mercury collector for thruster life testing is reviewed.
M.G.J.

N68-14320# Los Alamos Scientific Lab., N. Mex.
ELECTROMAGNETIC VELOCITY GENERATION IN ELECTRIC ARCJET ENGINES
Gerhard Kruelle and Helmut Huegel [1966] 30 p refs Transl. into ENGLISH from Z. Flugwiss. (Brunswick, W. Germany), v. 14, 1966 p 323–333
(LA-TR-67-33) CFSTI: HC $3.00/MF $0.65

The exhaust velocity of continuously operating electric arc jet engines may be considerably increased by electromagnetic forces. The effect of self-magnetic Lorentz forces on the features of supersonic flows is discussed. By means of hydrogen as a working gas, mean velocities up to 50,000 m/sec are measured by a thrustor in which the plasma is additionally accelerated by Hall effects.
Author (NSA)

N68-14331# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
DYNAMIC ANALYSIS TECHNIQUES FOR TURBINE ENGINE CONTROLS Summary Report, Sep. 1966–Aug. 1967

Arthur L. Bates Oct. 1967 175 p refs
(Contract F33615-67-C-1013)
(HSER-4794; AFAPL-TR-67-117; AD-662022)

The primary objective of the study was to develop practical techniques for the digital simulation of turbine engines and controls. The first steps involved the definition of detailed control component simulations, verification of these simulations by comparison with test data, and deriving a workable model of a turbine engine. The report summarizes the investigations conducted to date in these areas. Detailed simulations of four typical control components in several control media were developed and a fifth component is partially complete. Good agreement between the responses of the simulation, analytical and initial test data verified the simulation approach. The control components were modeled in a generic simulation language, MIMIC. Two simulation models of a complex turbofan engine were developed, and reviews with the engine manufacturer indicated that these simulations do exhibit the proper characteristics. The engine was simulated in the generic language, MIMIC, and a specific FORTRAN program for the engine was developed. The principal advantage to the FORTRAN program is that computer time, which becomes quite long for an extensive program, is reduced by a significant factor when compared to the time required by the MIMIC engine simulation. The present studies indicate that a specific FORTRAN program is most economical for extensive simulations and should be used on the development of control system simulations and in defining system assessment and optimization features. Author (TAB)

N68-14368* Princeton Univ., N. J. Guggenheim Labs. for the Aerospace Propulsion Sciences.
THEORETICALLY PREDICTED IGNITION TRANSIENTS IN SOLID PROPELLANT ROCKET MOTORS
G. F. di Lauro, L. H. Linden, W. J. Most, and Martin Summerfield Jul. 1967 132 p refs
(Grant NsG-200-60)
(NASA-CR-91778; Rept.-802) CFSTI: $3.00 CSCL 21H

The analysis in this paper is limited to the case of an internal burning grain with a pyrogen-type igniter located at the forward end of the rocket motor. Convection is assumed to be the dominant mode of heat transfer to the propellant. A system of equations is derived and then used to determine numerically the gas pressure, the gas temperature, and the burning area during the ignition transient of a series of hypothetical pyrogen-ignited rocket motors for various series of firings. This research indicated that, given the igniter characteristics, a measured heat flux distribution, and a suitable ignition criterion, the ignition transient for a given rocket motor can be predicted. Author

N68-14808 General Electric Co., Cincinnati, Ohio. Flight Propulsion Div.
STUDY AND TESTS TO REDUCE COMPRESSOR SOUNDS OF JET AIRCRAFT Quarterly Progress Report, Period Ending Mar. 31, 1967
William C. Sperry 31 Mar. 1967 187 p
(Contract FA-65-WA-1236)
(QPR-8)

A compilation of tables, graphs, and supporting photographs showing research and test accomplishments in a program to reduce turbomachinery noise by absorption and choked flow is presented. A large number of material configurations and choked flow techniques were investigated in specialized laboratory facilities, and fundamental performance variables were delineated. Specific areas investigated include noise reduction due to air flow, DC flow resistance, normal incidence absorption, and 15-inch laboratory compressor tests. C.T.C.

N68-14858* Boeing Co., Seattle, Wash.
THE EVALUATION OF A COMPOSITE TEFLON/ALUMINUM EXPULSION BLADDER FOR USE IN NITROGEN TETROXIDE
J. Carhart May 1966 52 p refs
(Contract NAS1-3800)
(NASA-CR-66535; D2-100645-1) CFSTI: $3.00 CSCL 21H

This report presents the results of an engineering test program designed to demonstrate the capabilities of a composite teflon/aluminum expulsion bladder for use in nitrogen tetroxide. The program encompassed investigation of gas transmission properties, susceptibility to repetitive cycling and vibration test, and long-term compatibility with nitrogen tetroxide. Test data verified the suitability of the design in all aspects. A maximum exposure time of 1630 hours (over twice maximum mission time) produced no deterioration of the bladder. The presence of the aluminum interfoil layer reduced the rate of nitrogen gas transmission by approximately two orders of magnitude. Accumulation of six expulsion cycles after subjection to Flight Acceptance and Qualification level vibration test produced no adverse effect on bladder capability. The composite teflon/aluminum expulsion bladder is to be incorporated into the oxidizer tanks of all Lunar Orbiter Flight spacecraft. Author

N68-14986 Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE FLOW IN A TWO DIMENSIONAL CASCADE
O. Scrofani Jun. 1966 50 p refs
(VKI-IN-16)

Different methods of two-dimensional incompressible flow analysis are used to study the properties of a modified axial-flow compressor blade. To determine the cascade performance, a correlation technique is used to obtain an approximation of the flow, and to relate the cascade behavior to the nominal conditions corresponding to 80% of the stalling deflection. Low speed wind tunnel tests were conducted to measure static and total pressures and flow direction in the plane of symmetry of the blade both upstream and downstream of the cascade, and the static pressure along the central blade. The integration method and the criteria used in considering the boundary layer effects are described. Details are also given on (1) a method of singularities, in which the aerodynamic field produced by an incompressible two-dimensional flow along the blade is simulated by superimposing the same flow for suitable singularities distributed along the profile chord; and (2) a rheoelectrical analogy, in which the same field is simulated by using the similarity between the equations for the electric and aerodynamic fields. M.G.J.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-14266# Joint Publications Research Service, Washington, D. C.
CLASSIFICATION OF ELECTROMAGNETIC WAVE SOURCES
S. I. Zilitinkevich 4 Jan. 1968 10 p Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Priborostr. (Leningrad), v. 10, no. 10, 1967 p 13–17
(JPRS-43874) CFSTI: HC $3.00/MF $0.65

Tabulated data are presented on the natural and industrial sources of electromagnetic energy. Natural electromagnetic energy is categorized as cosmic sources, terrestrial electrical phenomena, and terrestrial thermal sources. Industrial generators of electromagnetic waves are classified as incoherent vibrations, synchronous–cophasal and coherent oscillations, and electromagnetic oscillations. The characteristics of each source are discussed. M.G.J.

N68-14628*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

THE PRODUCTION OF COSMIC GAMMA RAYS IN INTERSTELLAR AND INTERGALACTIC COSMIC-RAY COLLISIONS. 4: GAMMA-RAY PRODUCTION FROM COSMIC PROTON–ANTIPROTON INTERACTIONS

Floyd William Stecker 20 Dec. 1967 35 p refs Sponsored in part by NASA

(NASA-CR-91830; SAO Special Rept.-261) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Various cosmological situations are discussed in which the annihilation of antimatter will produce cosmic gamma rays. An upper limit is placed on the amount of cosmic matter–antimatter interaction consistent with recent cosmic gamma-ray observations. It is shown that the production of mesons other than pions have little effect on the annihilation gamma-ray spectrum. It is also shown that gamma rays arising from annihilations at rest have energies between 5 and 865 MeV. The gamma-ray spectrum from annihilations at rest is calculated and compared with the calculations of Frye and Smith. A discussion is then presented of the various characteristics of proton–antiproton interactions in flight. Production of various mesons, hyperons, and isobars is discussed and cross sections are given. General implications of the data on the resultant gamma-ray spectra are stated. Author

N68-14673*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

THE PRODUCTION OF COSMIC GAMMA RAYS IN INTERSTELLAR AND INTERGALACTIC COSMIC-RAY COLLISIONS. 3: THE FORM OF THE COSMIC GAMMA-RAY SOURCE SPECTRUM FROM p–p INTERACTIONS FOR GAMMA-RAY ENERGIES LESS THAN 1 GeV

Floyd William Stecker 19 Dec. 1967 46 p refs Supported in part by NASA

(NASA-CR-91314; SAO Special Rept.-260) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The cosmic gamma-ray spectrum below 1 GeV arising from p–p interactions is calculated. Its properties are determined by the properties of secondary neutral pion production occurring at accelerator energies. First, a detailed discussion of the general properties of gamma-ray spectra arising from neutral pion decay is given. A determination is made of the various features of such spectra that must, in general, hold true. This discussion includes the results of analytic calculations of normalized gamma-ray spectra from ideal neutral pion energy distributions. An "isobar-plus-fireball" model is then chosen for numerical calculations in which the two dominant modes of neutral pion production at accelerator energies are production of the $N_3^*_{/2}(1.237)$ isobar and one fireball. Each of these modes of production then yields a component to the total gamma-ray spectrum. The components are summed and the results are given in terms of integral and differential gamma-ray spectra. A comparison is made with recent balloon data of gamma rays resulting from atmospheric high-energy interactions, and good agreement is found. Author

N68-14722# Kyoto Univ. (Japan). Inst. of Astrophysics.

DUHAMEL'S PRINCIPLE IN THE INTERNAL RADIATION FIELD

Masamichi Matsumoto Repr. from Publ. Astron. Soc. Japan, v. 18, no. 4, 1966 p 456–465 refs *Its* Contrib. No. 154

CFSTI: HC $3.00/MF $0.65

In the theory of radiative transfer, Duhamel's principle for scattering- and transmission-functions is well known and plays an important role. However this principle in an internal radiation field has not been formulated. In this paper we formulate the Duhamel principle for an internal radiation field in an inhomogeneous finite or semi-infinite atmosphere, based on the existence and uniqueness theorem for the solution of Milne's integral equation. Author

N68-14723# Kyoto Univ. (Japan). Inst. of Astrophysics.

THE FUNCTIONAL EQUATIONS IN THE RADIATION FIELD. 1: MONODIRECTIONAL ILLUMINATION OF THE UPPER SURFACE

Masamichi Matsumoto Repr. from Publ. Astron. Soc. Japan, v. 18, no. 4, 1966 p 445–455 refs *Its* Contrib. No. 153

CFSTI: HC $3.00/MF $0.65

With the aid of invariant imbedding technique and Duhamel's principle, we formulate a set of functional equations in the internal radiation field in a finite, inhomogeneous, plane-parallel and isotropically-scattering atmosphere whose upper surface is illuminated by parallel rays in a specified direction. These functional equations govern the S- and T-functions expressed in terms of X- and Y-functions. A half of the complete set of the functional equations for the S- and T-functions is composed to these integro-differential equations. Author

N68-14724# Kyoto Univ. (Japan). Inst. of Astrophysics.

PHOTON ESCAPE PROBABILITY

Akira Uesugi Repr. from Publ. Astron. Soc. Japan, v. 18, no. 4, 1966 p 437–444 refs *Its* Contrib. No. 152

CFSTI: HC $3.00/MF $0.65

The escape probability of a photon from homogeneous plane parallel medium is examined in detail. The coherent scattering process is treated. The equation for a function which describes the mean number of photon scatterings is formulated. It is shown, that the integral equation for this function has the same kernel as that in the usual auxiliary equation. Also shown is that the equation for the mean number of photon scatterings in the case of diffuse reflection and transmission of light by the slab can be formulated with the aid of Chandrasekhar's X and Y functions. Author

N68-14786# Utrecht Observatory (Netherlands).

A COLLECTION OF SPECTRAL DIAGRAMS OF SOLAR RADIO TYPE 4 EVENTS

A. D. Fokker Repr. from Utrechtse Sterrekundige Overdrukken, no. 23, 1967 p 309–324 refs

Presented are several spectral diagrams of solar radio type IV events which occurred between 1960 and 1966. Most of the diagrams were prepared at the Utrecht Observatory. The diagrams are based on a number of single-frequency records contributed by several observatories. Reference data pertaining to the diagrams are included with a listing of these observatories. K.W.

N68-14787 Kyoto Univ. (Japan). Inst. of Astrophysics.

BALMER DECREMENTS IN HYDROGEN EMISSION LINES 1

Ryuko Hirata and Akira Uesugi Repr. from Mem. Coll. Sci., Univ. Kyoto, Series A, v. 31, no. 2, 1967 p 199–239 refs *Its* Contrib. No. 156

An extension of Sobolev's dynamical treatment on the radiation field of extended stellar envelope is examined. The cyclic equations are solved in connection with the escape probability of photon. A medium of hydrogen atoms with seven levels is considered. The numerical results give reasonable values of Balmer decrements for higher series member, when compared with the observed data on

B_e stars. However, the dilution factor for the extended envelope of these objects derived by fitting the computed Balmer decrements to the observed values is smaller than the values obtained from other method. A more detailed consideration on the equation of radiative transfer seems to be required. Author

N68-14809* Maryland Univ., College Park.
PLASMA MECHANISMS FOR SOLAR RADIO BURSTS
D. A. Tidman 1967 21 p refs Presented at the AAAS Meeting, New York, 27 Dec. 1967
(Grant NsG-220-62)
(NASA-CR-91665) CFSTI: $3.00 CSCL 20I

We shall restrict our discussion to a consideration of mechanisms for Type II (so-called slow drift bursts) and Type III (fast drift) bursts. It has been suggested that the radiation emitted in these bursts has its origin in longitudinal electron plasma oscillations excited in the coronal plasma. These electron plasma oscillations convert part of their energy into electromagnetic radiation of frequency ω_e by scattering off density fluctuations (ion waves) in the corona, and part into radiation at $2\omega_e$ by scattering of longitudinal electron plasma waves off each other. Detailed calculations have shown that most of the features of Type II bursts can be understood this way. In the following model it is shown that the electron plasma oscillations could be excited by suprathermal electron fluxes behind a "collisionless" shock wave rising through the corona above a solar flare. Although the same basic radiation process is almost certainly also responsible for Type III bursts, some difficulties arise when one looks closely at the radiation process in this case. Author

N68-14913# Kyoto Univ. (Japan). Inst. of Astrophysics.
ON THE WIDTHS OF BALMER EMISSION LINES IN PROMINENCES
Ichiro Kawaguchi Repr. from Publ. Astron. Soc. Japan, v. 18, no. 4, 1966 p 362–373 refs *Its* Contrib. No. 151
CFSTI: HC $3.00/MF $0.65

The possible fine structure of a prominence may be important in the interpretation of line profiles. Equations are developed for estimating the decrement of Balmer line widths and Hα-profiles when the fine components are distributed as a function of radial velocity only. From a comparison with observation, the kinetic temperature, mean radial velocity of fine threads and the optical thickness of the prominence are obtained. The kinetic temperature 6600° of fine threads derived from three prominences among five, agrees very well with the temperature obtained from the continuous spectrum by the author. Author

N68-14935*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE PRODUCTION OF COSMIC GAMMA RAYS IN COSMIC RAY COLLISIONS. 5: GAMMA RAY PRODUCTION FROM COSMIC ELECTRON POSITRON ANNIHILATION
F. W. Stecker 21 Dec. 1967 29 p refs Sponsored in part by NASA
(NASA-CR-91831; SAO Special Rept.-262) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The annihilations of free electrons and positrons and of positronium are discussed and cross sections are given. Positronium formation under astrophysical conditions is then discussed. A general formula is derived that gives the gamma ray spectrum from the annihilation of cosmic ray positrons in terms of the positron source spectrum, energy loss rate, and annihilation cross section given as functions of energy. The gamma ray spectrum from secondary positrons is determined. The secondary positrons are considered to arise from the decay of positive mesons that are produced in galactic cosmic-ray p–p and p–α interactions. Author

N68-14952*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
RADIATION ENVIRONMENT AT HIGH ORBITAL ALTITUDES
Peter W. Higgins, Joseph C. Lill, and Timothy T. White *In its* Gemini Sum. Conf. 1967 p 149–157 refs (See N68-14941 05-30)

Presented is a discussion of the characteristics of the Van Allen trapped radiation belt at high altitudes, and the effects of this radiation environment on the Gemini X and XI space flights. Included is an analysis of premission planning for the radiation flights, and inflight radiation measurements. Significant results of these studies were: (1) The high altitude flights of Gemini X and XI demonstrated that manned space flight at higher altitudes is possible with a minimum of radiation dose. (2) Reasonable agreement was found between preflight calculations and the measured values of radiation dose, thus providing greater confidence for further exploration on the Apollo missions. S.C.W.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-13918# Royal Inst. of Tech., Stockholm (Sweden). Stockholm Observatory (Sweden). Div. of Plasma Physics.
ON THE ROTATION OF THE EARTH PRODUCED BY GRAVITATIONAL ACCRETION OF PARTICLES
R. T. Giuli Sep. 1967 42 p refs Sponsored by Swedish Sci. Res. Council Jointly Prepared with Stockholm Obs.
(Rept.-67-19) CFSTI: HC $3.00/MF $0.65

Particles which are gravitationally attracted to impact the planetoid-earth in a series of bands originating from circular, heliocentric orbits contribute retrograde spin during the growth of the planetoid. Particle bands originating from eccentric, heliocentric orbits contribute both prograde and retrograde spin during the planetoid growth. The spin rate is shown to be asymptotic with respect to mass; for the earth this results in a prograde period of 7.3 hours. Author (ESRO)

N68-13919# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
SOLAR ACTIVE REGIONS IN MG 2 LIGHT
Kerstin Fredga Oct. 1967 6 p ref Presented at the 35th IAU Symp. on Struct. and Develop. of Solar Active Regions, Budapest, 4–8 Sep. 1967
(Rept.-67-22) CFSTI: HC $3.00/MF $0.65

During 1965 two rockets were launched in order to obtain monochroma pictures of the sun in the Mg II line at 2802.7Å. The Mg II filterheliograms have been compared with simultaneous Hα and Ca II K spectroheliograms. An important observation from both flights concerns the relative intensities of different active regions. In the Hα pictures there are old fairly faint active regions and newly formed more intense regions. In the Mg II pictures however the older regions appear more intense than the younger regions. Different explanations for this intensity reversal effect have been considered. The effect has also been looked for in broad band Ca II H filterheliograms, however with negative results. Author (ESRO)

N68-13944 Lockheed Missiles and Space Co., Sunnyvale, Calif.
MOST ADVANTAGEOUS PROGRAM FOR THE PITCH ANGLE FOR CONSTANT FUEL CONSUMPTION IN THE POWERED PHASE

M. K. Tikhonravov, I. M. Iatsunskii, G. Iu. Maksimov, I. K. Bazhinov, and O. V. Gurko 1967 8 p Transl. into ENGLISH from the book "Principles of the Theory of Flight and Projection Elements of Artificial Earth Satellites" Moscow, Mashinostr., 1967 p 30–38

A mathematical discussion is presented on optimal pitch angle determination, using boundary conditions yielding maximum altitude. The differential equations of motion are applied to a two-stage booster. It was concluded that there is an optimum value of the number of satellite turns, and that the optimum orbits for the situation considered are elongated ellipsoids. N.E.N.

N68-14086# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SPACE ARROW INVESTIGATES THE ATMOSPHERE
G. V. Rozenberg, M. S. Malkevich, A. M. Kasatkin, and Iu. I. Zaitsev [1967] 6 p Transl. into ENGLISH from Priroda (Moscow), no. 9, 1967 p 69–73

The meteorological instrumentation on Cosmos-149 is briefly described. Among the parameters determined are reflected solar radiation, the vertical construction of the cloud cover, water vapor, and the earth's brightness field. The satellite's stabilization system is also mentioned. N.E.N.

N68-14089*# North American Aviation, Inc., Downey, Calif.
GUIDANCE, FLIGHT MECHANICS AND TRAJECTORY OPTIMIZATION. VOLUME 3: THE TWO-BODY PROBLEM
G. E. Townsend and M. B. Tamburro Washington NASA Jan. 1968 87 p refs
(Contract NAS8-11495)
(NASA-CR-1002; SID-65-1200-3) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The approximate analysis of the motion of near-earth satellites, and/or the generation of precise trajectories via derivatives of an Encke formulation or via an osculating conic formulation, is the fundamental objective of this monograph. This objective will be achieved by developing the classical solution and modifying its form to assure that a completely deterministic solution is available. The two-body problem was one of the earliest problems in dynamics to be solved. Thus, the material to be presented does not represent the current status of a rapidly changing field on analysis as do some of the presentations in other monographs. Rather, the material is intended to express the results of these previous analyses, to express the observations regarding indeterminacies in the most commonly used form of the solution, and to provide alternate formulations of the motion to avoid the computational problems. In addition, this presentation is intended to function as a reference volume providing detailed tabulations of equations relating the most basic parameters of the motion and the dynamics. Author

N68-14137# Bolkow Entwicklungen K. G., Munich (West Germany).
MISSION PROFILE OF AN ASTEROID SONDE [MISSION PROFILE EINER ASTEROIDEN-SONDE]
Wolfgang Kokott [1967] 37 p refs In GERMAN Presented at DGRR Symp. on Interplanetary Aerospace Missions, Munich, 7 Dec. 1967
(RF-86-0; DGRR-67-027)

Various criteria for flight trajectories of asteroid sondes are discussed with emphasis on practical realization aspects and timing phases. Asteroid fly-through missions with their meteoroid hazards to space vehicles require a precise knowledge of meteoroid density between Mars and Jupiter orbits where the main concentration of asteroids is found. Transl. by G.G.

N68-14150*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MANNED SPACEFLIGHT EXPERIMENTS GEMINI 10 MISSION Interim Report
Mar. 1967 145 p refs
(NASA-TM-X-60791; MSC-TA-R-67-1) CFSTI: HC $3.00/MF $0.65 CSCL 22B

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8. EXPERIMENT S006 (S-6), SYNOPTIC WEATHER PHOTOGRAPHY K. M. Nagler and S. D. Soules (Environ. Sci. Serv. Admin.) p 73–79 (See N68-14158 05-14)

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N68-14159*# Dudley Observatory, Albany, N. Y.
EXPERIMENT S010 (S-10), AGENA MICROMETEORITE COLLECTION
Curtis L. Hemenway *In* NASA. Manned Spacecraft Center Manned Spaceflight Expt. Gemini 10 Mission Mar. 1967 p 81–88 (See N68-14150 05-30)

Micrometeoroid impacts have been recorded during the 4-month exposure of experiment S010 (S-10) equipment. A partial examination revealed two macroscopic craters; two microscopic craters were found as a result of scanning one-quarter of the total area. Further work has been delayed to make use of a recently installed scanning electron microscope. With the number of impacts located, the flux values found from the satellite microphone experiments are approximately confirmed. Author

N68-14160*# Dudley Observatory, Albany, N. Y.
EXPERIMENT S012 (S-12), MICROMETEORITE COLLECTION
Curtis L. Hemenway *In* NASA. Manned Spacecraft Center Manned Spaceflight Expt. Gemini 10 Mission Mar. 1967 p 89–95 (See N68-14150 05-30)

The micrometeorite collection experiment during the Gemini 10 flight was to determine the micrometeorite activity by exposing

a polished metal plate and plastic surfaces to the environment outside the spacecraft. However, the flight crew reported that the hardware could not be located in the spacecraft and that it might have floated through the open hatch; thus, no results have been reported. G.G.

N68-14162*# Electro-Optical Systems, Inc., Pasadena, Calif.
EXPERIMENT S026 (S-26), ION-WAKE MEASUREMENT
David B. Medved *In* NASA. Manned Spacecraft Center Manned Spaceflight Expt. Gemini 10 Mission Mar. 1967 p 105–114 *ref* (See N68-14150 05-30)

Ion-wake measurements of the ambient medium produced by the orbiting Gemini spacecraft were used: (1) to map ion density wake as a function of position coordinates relative to the reference frame of the spacecraft; (2) to contour map the electron density wake as a function of the same position coordinates; (3) to determine electron temperature as a function of the position coordinates; (4) to obtain information on ambient ion and electron densities and electron temperature as a function of altitude and diurnal variations from the Gemini/Agena target vehicle; and (5) to obtain the ionization transients caused by the spacecraft thruster firings. A brief analysis of the collected data indicated that electron and ion temperatures were higher than estimated. Spacecraft wake structure was observed out to a distance of 100 feet from the vehicle; also observed was some oscillatory behavior in the wake structure. G.G.

N68-14170 Academy of Sciences (USSR), Moscow.
RESULT OF OBSERVATIONS OF SOVIET ARTIFICIAL EARTH SATELLITES, NUMBER 87
1966 41 p In RUSSIAN

Observations of equatorial coordinates during October 1964 are tabulated for 19 Soviet artificial satellites in the Cosmos, Polyot, Elektron, and Voskhod series. Remarks are also presented in a dinomic code, along with times of observation. Transl. by E.C.

N68-14174 Academy of Sciences (USSR), Moscow.
RESULT OF OBSERVATIONS OF SOVIET ARTIFICIAL EARTH SATELLITES, NUMBER 86
1966 40 p In RUSSIAN

September and October 1964 horizontal coordinates are given for fifteen Soviet artificial satellites: Polyot 2, Elektron 1 and 2, and Cosmos 17, 25, 26, 31, 36, 40, 42, 44, 45, 46, 47, and 49. Tables show time data, and remarks in a dinomic code. Transl. by E.C.

N68-14180 Academy of Sciences (USSR), Moscow.
RESULT OF OBSERVATIONS OF SOVIET ARTIFICIAL EARTH SATELLITES, NUMBER 89
1966 37 p In RUSSIAN

Equatorial and horizontal observations are presented for eleven Soviet artificial satellites during December 1964. Tables contain time information and remarks in a dinomic code. The satellites are: Polyot 1 and 2, Elektron 1 and 3, and Cosmos 17, 38, 42, 43, 44, 49, and 51. Transl. by E.C.

N68-14216* California Univ., San Diego.
THE PECULIAR GALAXY NGC 7714
Marie-Helene Demoulin, E. Margaret Burbidge, and G. R. Burbidge Nov. 1967 26 p refs
(Grant NsG-357)
(NASA-CR-91800) CFSTI: $3.00 CSCL 03B

NGC 7714, one of the components of the system VV51, has an emission-line spectrum indicating strong excitation, and velocity gradients in the excited gas which are probably due to rotation but may include non-circular motions also. [OI] λ6300 which has so far been detected only in Seyfert galaxies, is present in the center, and the emission-line strengths approach those in Seyfert nuclei, but the lines do not show the characteristic Seyfert broadening. The mass is small (a few $\times 10^9$ $M_\odot$) but cannot be precisely determined because of uncertainty in the orientation and the possible presence of non-circular motion. Author

N68-14239# Harvard Coll. Observatory, Cambridge, Mass.
NEW SKY PATROL PROGRAM
Hector C. Ingrao and Donald H. Menzel 15 Dec. 1967 74 p refs
(Grant NSF GP-5017)
(Rept.-1)

A detailed discussion is given of the sky patrol program and the cameras which photograph the same region simultaneously in blue, yellow, and red portions of the spectrum. The installations and facilities in Massachusetts and in the Orange Free State, Republic of South Africa, are described, along with the photographic and data processing aspects. It is expected to determine stellar magnitudes with great accuracy with the new three-color photometric system, and because of this a new sky atlas is planned. N.E.N.

N68-14242 Congress. House. Committee on Science and Astronautics.
REVIEW OF THE SOVIET SPACE PROGRAM WITH COMPARATIVE UNITED STATES DATA
Washington GPO 1967 143 p Hearings before Comm. on Sci. and Astron., 90th Congr., 1st Sess.
GPO: $0.35

The space program development, policy and plans, launching facilities, and flights are discussed. Space flight statistics are tabulated for both Russia and the United States. The spacecraft and the scientific data obtained with them are reviewed from the early Sputniks of 1957–58 to the renewed manned flight of 1966–67. N.E.N.

N68-14261* Techtran Corp., Glen Burnie, Md.
OPTIMIZATION OF FLIGHT TRAJECTORIES BY ITERATIVE APPLICATION OF THE MAXIMUM PRINCIPLE (MIN-H-METHOD) [OPTIMIERUNG VON FLUGBAHNEN DURCH ITERATIVE ANWENDUNG DES MAXIMUM-PRINZIPS (MIN-H-METHODE)]
Ernst D. Dickmanns Washington NASA Jan. 1968 31 p refs Transl. into ENGLISH from German Presented at the Ann. Meeting of WGLR/DGRR, Karlsruhe (West Germany), 1967
(Contract NASw-1695)
(NASA-TT-F-11459) CFSTI: $3.00 CSCL 22C

A numerical method is described that develops a series of control functions, starting from non-optimal control functions, through iterative application of the maximum principle in such a way that the limit function of the series meets the necessary conditions for an optimum. The method is compared with the gradients procedure for the simplest case. Experiments in application to three-dimensional free flight trajectories are discussed. The method has the convergence range of the gradients method, but it converges substantially faster in ranges in which the target function does not respond to control variables, and after fulfilling the convergence criterion it yields approximate solutions of Euler's equations. Author

N68-14305*# Princeton Univ., N. J.
THE SIGNIFICANCE FOR THE SOLAR SYSTEM OF TIME VARYING GRAVITATION
A. H. Dicke *In* NASA. Goddard Inst. for Space Studies Lectures on Gravitation and Relativity, Vol. 2 [1966] 59 p refs (See N68-14304 05-23)

A discussion is presented on how Einstein's general theory of relativity can be modified to overcome in part its absolute

space–time character. A second field quantity is introduced into the equations, and these modifications are related to some of the problems connected with geophysics and astrophysics. It is shown explicitly that in addition to the gravitational field which is connected with the geometry of space, one can have long-range matter-type of fields. C.T.C.

N68-14307*# Princeton Univ., N. J.
THE DEGENERATE STAR. A RELATIVISTIC CATASTROPHE
J. A. Wheeler *In* NASA. Goddard Inst. for Space Studies Lectures on Gravitation and Relativity, Vol. 2 [1966] 37 p (See N68-14304 05-23)

The structure of stars of high density at zero temperature is examined. It is assumed that the star has reached the end point of thermonuclear evolution and all the elements are in a state of statistical equilibrium. Emphasis is placed on attempts to determine the mass limit for such stars, and if there is, what would happen if such mass limit is exceeded. It is concluded that (1) in stars heavier than the limiting mass, the force of the degenerate pressure is never sufficient to balance gravity, (2) that a star lighter than the limiting mass is able to balance gravity with degenerate pressure, and (3) that to achieve this balance in the latter case the star has to adjust its radius to the value prescribed by the mass-radius relation for degenerate models. C.T.C.

N68-14309*# Princeton Univ., N. J.
POSSIBLE EFFECTS ON THE SOLAR SYSTEM OF ϕ WAVES
R. H. Dicke *In* NASA. Goddard Inst. for Space Studies Lectures on Gravitation and Relativity, Vol. 2 [1966] 34 p (See N68-14304 05-23)

The existence and some possible effects of ϕ waves, defined to be waves in a long-range scalar field, are discussed. The properties of these waves are described, and are shown to derive from the requirements of relativistic invariance and the results of certain experimental observations. Various unexplained effects such as earthquakes, planetary orbital changes, and gravity disturbances are discussed in the light of the existence of such waves. C.T.C.

N68-14328# Kyoto Univ. (Japan). Kwasan Observatory.
CONVECTIVE GROWTH RATES IN THE CASE OF VARYING SUPERADIABATIC GRADIENT
Schichiro Yamaguchi Repr. from Mem. Coll. Sci., Univ. Kyoto, Series A, vol. 31, no. 2, 1967 p 153–160 refs *Its* Contrib. No. 155

The problem of determining convective growth rates of initially given disturbances in the thin fluid layer of varying superadiabatic temperature gradient is investigated. For some model variations of the gradient the growth rates and the eigenfunctions are obtained by solving a second order differential equation where the viscosity is neglected and the disturbances are assumed to be optically thin or adiabatic. The validity of the variational method is examined. When a suitable trial function (including only one variational parameter) is adopted, the approximate eigenvalue agrees with the exact value for the fundamental mode within the limit or error of a few percent (except for very small wavenumbers of disturbances) for a variety of the superadiabatic gradient. Author

N68-14436# Miami Univ., Fla. Inst. of Marine Science.
STUDIES ON IRON METEORITES Annual Progress Report, Jan. 1–Dec. 31, 1966
David E. Fisher 3 Feb. 1967 58 p refs
(Contract AT(40-1)-3585)
(ORO-3585-1) CFSTI: HC $3.00/MF $0.65

Research is reported on: cosmogenic tritium problems in iron meteorites, space erosion effects in iron meteorites, aluminum abundance in chondrites and chondrules, isotopic abundances of xenon in meteorites, elemental abundances in microtektites, abundance of chlorine in iron meteorites, and potassium/argon ages in iron meteorites. NSA

N68-14440 Academy of Sciences (USSR), Moscow.
RESULT OF OBSERVATIONS OF SOVIET ARTIFICIAL EARTH SATELLITES, NUMBER 88
1966 26 p In RUSSIAN

November 1964 astronomical observations of eleven Soviet artificial satellites are presented. Times of observation, equatorial and horizontal coordinates, and remarks in a dinomic code are tabulated for Cosmos, Polyot, and Elektron series satellites. Transl. by E.C.

N68-14443* California Univ., San Diego. Dept. of Physics.
ON THE NATURE OF SOME GALACTIC X-RAY SOURCES
K. H. Prendergast (Columbia Univ.) and G. R. Burbidge [1967] 19 p refs Sponsored in part by NSF
(Grant NsG-357)
(NASA-CR-91799) CFSTI: $3.00 CSCL 03B

A model to explain the generation of X-ray sources in close binary systems is described. It is concluded that models of this type may be able to account for the X-ray flux emitted by Scorpius X-1 and Cygnus X-2. Author

N68-14470 Academy of Sciences (USSR), Moscow.
RESULT OF OBSERVATIONS OF SOVIET ARTIFICIAL EARTH SATELLITES, NUMBER 90
1966 27 p In RUSSIAN

Astronomical observations are tabulated for fifteen artificial satellites in the Cosmos, Polyot, and Elektron series. The tables are for January 1965 data and contain equatorial and horizontal coordinates, times of observation, and encoded remarks. Transl. by E.C.

N68-14508* Lockheed Missiles and Space Co., Huntsville, Ala.
TRAJECTORIES TO THE OUTER PLANETS VIA JUPITER SWINGBY
M. F. Jones Jan. 1968 384 p refs
(Contract NAS8-20082)
(NASA-CR-61186) CFSTI: $3.00 CSCL 22C

A close encounter with Jupiter on a flyby (swingby) trajectory has the effect of a propulsive maneuver on the heliocentric trajectory thereby resulting in an increase of energy, decrease of energy, or a plane change and energy change. Data are presented where the gravity field of Jupiter is utilized to increase the heliocentric energy for flights to the outer planets Saturn, Uranus, Neptune, and Pluto. The earth launch opportunities considered are for time period of 1976 to 1982. Mission duration which require earth departure energy (C_3) in the range of 85 to 200 km^2/sec^2 is considered. Earth departure windows of 1, 10 and 30 days are summarized and pertinent parameters are given for earth departure phase, Jupiter encounter phase, and target planet approach phase. Author

N68-14553* California Univ., San Diego.
ABSORPTION LINES IN QUASI-STELLAR OBJECTS
G. R. Burbidge and E. M. Burbidge [1967] 4 p refs Sponsored in part by NSF
(Grant NsG-357)
(NASA-CR-91731) CFSTI: $3.00 CSCL 03B

The red shifts in emission and absorption line spectra of quasars are briefly discussed. It is found that the absorption-line red shifts are either approximately equal to the emission-line shifts or have standard value of about 1.95. It is felt that in either case the region producing the absorption lines is close to the radiation source. It is therefore concluded that the red shifts in the absorption spectra are not due to intercepting galaxies but are either intrinsic or cosmological. N.E.N.

N68-14583*# Northrop Corp., Huntsville, Ala.
LABORATORY SIMULATION OF THE MARS ATMOSPHERE. A FEASIBILITY STUDY
T. S. Chang, W. C. Lucas, and W. W. Youngblood Jan. 1968 110 p refs
(Contract NAS8-20082)
(NASA-CR-61188) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The feasibility, from a scientific and engineering design criteria standpoint, of simulating the Martian atmospheric process is considered. Three general areas are studied in detail: 1) simulation of the transporation and deposition of dust and sand by atmospheric processes, 2) dissociation and absorption properties of molecular constituents of the Martian atmosphere, and 3) thermodynamic properties of the Martian atmosphere. Author

N68-14622# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
STUDY OF THE VELOCITY REQUIREMENTS FOR ABORTING MANNED MISSIONS TO THE PLANETS MARS AND VENUS BETWEEN 1977 AND 1986
Alain G. Mons 14 Jun. 1967 25 p Presented at the Am. Astronautical Soc. Natl. Symp., Huntsville, Ala., 12–14 Jun. 1967
(Douglas Paper-4453)

The velocity increments required for aborting manned missions to the planets Mars and Venus with departure from a 200-nmi circular parking orbit are presented. The analysis is restricted to that part of the Earth to a planet trajectory between the parking orbit and the sphere of influence of the target planet. A comparison of the Delta-V capability for typical spacecraft configurations with the required Delta-V shows if an abort is possible, and at what times. The effect of providing the basic vehicle with the velocity capability necessary for aborting the mission is shown. Although emphasis is put on the minimum Delta-V requirements for aborting the missions considered, the data presented allow the converse approach of minimizing the return times and defining the related required velocity increments. Author

N68-14691# Belgian Royal Observatory, Uccle.
ON THE EVOLUTION OF DOUBLE STARS
J. Dommanget, ed. 1967 250 p refs In FRENCH and ENGLISH Collog. of the Intern. Astron. Union held, Uccle, Belgium, 29 Aug–2 Sep. 1966

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N68-14692# Naval Observatory, Washington, D. C.
GENERAL INTRODUCTORY LECTURE
K. Aa. Strand *In* Belgian Roy. Obs. on the Evolution of Double Stars 1967 p 19–24 (See N68-14691 05-30)

An overview of knowledge relating to double stars is presented in this introductory lecture to a conference sponsored by the International Astronomical Union. It is noted that while the general theory of evolution has not changed substantially during the last 10 years, there has been impressive progress in stellar structure theory and improved understanding of complex hydrodynamical phenomena. Mention is made of a recent catalog of orbits of visual binaries, binaries that contain components below the main sequence, masses and luminosities of white dwarfs, and the evolution of stars of very low mass. M.W.R.

N68-14693# Belgian Royal Observatory, Uccle.
DEFINITION OF THE TERM DOUBLE STAR [DEFINITION DE L'OBJET "ETOILE DOUBLE"]
J. Dommanget *In its* On the Evolution of Double Stars 1967 p 25–54 refs In FRENCH and ENGLISH (See N68-14691 05-30)

Orbital and linear movement as well as physical coupling in the stellar medium are discussed in a session related to defining a double star. Distinction is made between physical and optical coupling; and static, dynamic, and statistical criteria are discussed in thisoregard. Static criteria are based on differences in parallax or apparent magnitude, distance of apparent separation, and distance of apparent separation and global magnitude. The importance of relative movement, properties of apparent relative movement, and nature of real relative movement are the basis for the dynamic criteria; and statistical criteria are based on the establishment of frequency functions. The frequency distribution of separations and mass ratios of early-type double stars, faint wide pairs in the north polar cap, and some results of binary statistics are discussed. Transl. by M.W.R.

N68-14694# Sproul Observatory, Swarthmore, Pa.
GENESIS OF BINARIES
S. L. Lippincott *In* Belgian Roy. Obs. On the Evolution of Double Stars 1967 p 55–82 refs (See N68-14691 05-30)

Capture, accretion, scission, and novae are considered in relation to theories of star formations. Following introductory remarks about the origin of binary stars, attention is given to the effect of rotation and magnetic fields on the formation of single and multiple stars,; and pre-main-sequence contraction of spherical and rotating stars, properties of binary stars, and effect of magnetic field are considered. Orbital planes and space motions of visual binaries are treated, as is the evolution of small stellar systems and the formation of double stars. M.W.R.

N68-14695# Czechoslovak Academy of Sciences, Ondrejov. Astronomical Inst.
INTERNAL STRUCTURE AND EVOLUTIONARY CHANGES IN BINARIES
M. Plavec *In* Belgian Roy. Obs. On the Evolution of Double Stars 1967 p 83–132 refs (See N68-14691 05-30)

Evolution in wide pairs and binaries, theoretical comparisons with observations, and hypotheses of mass exchange are treated in an introduction to a session on internal structure and evolutionary changes in binaries. Discussions center around the structure of nonspherical stars, variations of orbitals and tidal influences, and evolution of massive and close binaries. Close binaries are considered during burning and after exhaustion of hydrogen in the core of the primary, and for the case of primaries with initial masses larger than 3.3 to 5.0 M. M.W.R.

N68-14696# Warsaw Univ. (Poland). Astronomical Observatory.
MASS LOSS AND VARIATIONS OF THE ORBITAL ELEMENTS
S. L. Piotrowski *In* Belgian Roy. Obs. On the Evolution of Double Stars 1967 p 133–179 refs In FRENCH and ENGLISH (See N68-14691 05-30)

Changes introduced into the relative motion of the components of a binary system are discussed in terms of the ejection of matter

from one component and the possible transfer to a second component. Star position and velocity variations are obtained from two general principles, namely the motion of the center of mass and the conservation of momentum. Isotropic loss of mass, directional ejection of matter, influence of ejected matter on component motion, nonsynchronous rotation as the driving-mechanism of mass ejection, and variations in period of revolution and eccentricity are discussed. Following this introductory lecture, some dynamical phenomena influencing the evolution of close binary systems are reviewed, and attention is given to the exchange of matter and transfer of angular momentum between the orbital and rotational motions in close binary systems. Angular moments of these close binaries are treated, as is the evolution of the visual binary L 726-8. M.W.R.

N68-14897# Observatoire du Mont-Gros, Nice (France).
MASS-LUMINOSITY RELATION AND DIAGRAM H-R IN THE CASE OF BINARIES [RELATION MASSE-LUMINOSITE ET DIAGRAMME H-R DANS LE CAS DES BINARIES]
P. Couteau *In* Belgian Roy. Obs. On the Evolution of Double Stars 1967 p 181–214 refs In FRENCH and ENGLISH (See N68-14891 05-30)

Astronomical, photometric, and spectroscopic methods used in the study of binaries and mass luminosity relations are reviewed; and consideration is given to the use of H–R (Hertzsprung–Russell) diagrams. A photoelectric scanning technique is described for the photometry and astrometry of double stars; and a very advanced type of visual binary is discussed. A search for subdwarfs among visual binaries is reported, physical pecularities of components of double stars are noted, and rotation law of the components of eclipsing binaries is considered. Spectra and rotational velocities of visual double stars are treated, and four interesting visual binary systems are described. M.W.R.

N68-14898# Minnesota Univ., Minneapolis.
MULTIPLE STAR SYSTEMS AS RELATED TO DOUBLE STARS
W. J. Luyten *In* Belgian Roy. Obs. On the Evolution of Double Stars 1967 p 215–234 refs (See N68-14891 05-30)

Frequency of multiple systems among visual and spectroscopic binaries is discussed, as are secular perturbations among the visual binaries. It is estimated that approximately 33% of binaries are at least triple systems, and that approximately 28% of the triple systems are at least quadruple. Multiple systems with relative motion are tabulated with and without orbit. Relative orbital motion in orbital systems is summarized, and relative orbital angles among multiple stars is tabulated. M.W.R.

N68-14733*# Alabama Univ. Research Inst., Huntsville.
THE STUDY OF PARAMETER OPTIMIZATION IN VEHICLE-BORNE TRACKING SYSTEMS Final Technical Report
George D. Cole, Richard Jacob, J. C. Chang, and R. J. Polge Dec. 1966 87 p refs
(Contract NAS8-5411)
(NASA-CR-91809; UARI-40) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A data smoothing technique is developed for an optimum determination of the orbital parameters of a free flight orbit. A position vector for the satellite is determined from three range measurements, one from each of three stations. The smoothing technique differs from conventional sampling theory because the variance of a sample is a function of the relative position of the satellite and of the station. The only orbital parameter is the radius if the orbit is circular, and a formula to estimate the radius with one vector position measurement is derived. If the orbit is elliptical the three orbital parameters can be determined by three position vector measurements. It is concluded that the smoothing technique is quite powerful and general, and can be used to determine constant parameters which are explicitly or implicitly functions of sampled values and of random variables. C.T.C.

N68-14916# Padua Univ. (Italy). Astrophysical Observatory.
ON THE DYNAMICS OF NGC 4449
Francesco Bertola 1967 5 p refs Presented at the 10th Meeting of the Ital. Astron. Soc., Catania, Italy, 27–29 Jun. 1966 *Its* Contrib. No. 191 from the Astrophys. Obs. of Padua Univ.
CFSTI: HC $3.00/MF $0.65

The velocity curve derived at Asiago for NGC 4449 shows that the galaxy does not possess appreciable rotation around the apparent minor axis. Random motions should be responsible for the velocity dispersion of 150 km/s detected at 21 cm. Author

N68-14917# Kyoto Univ. (Japan). Inst. of Astrophysics.
AN APPROXIMATE EXPRESSION FOR NONGRAY TEMPERATURE DISTRIBUTION
Yasuko Hasegawa and Akira Uesugi Repr. from Mem. Coll. Sci., Univ. Kyoto, Series A, v. 31, no. 2, 1967 p 303–309 refs *Its* Contrib. No. 157
CFSTI: HC $3.00/MF $0.65

An approximate expression for nongray temperature distribution with given T_0/T_e is formulated. If a model atmosphere is constructed with the aid of Avrett–Krook iterative method, taking this expression as an initial temperature distribution, much of the iteration time can be reduced. It is shown that for models with T_e=15,000°K, and 20,000°K, after only 2 iterations, model atmospheres can be obtained in which the departures of computed radiative fluxes from the assumed one is less than 1.5%. Author

N68-14921 Latvian P. Stuchka State Univ., Riga.
EARTH'S ROTATION IRREGULARITIES Study Report No. 96
1967 147 p refs In RUSSIAN
CFSTI: $3.00

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2. ABOUT CHOICE OF COEFFICIENTS OF FRICTION BETWEEN ATMOSPHERIC AIR AND EARTH K. Steins and E. Kaupusa p 32–37 refs (See N68-14923 05-13)

3. INVESTIGATION OF THE SYSTEM OF OBSERVATIONS DURING THE YEARS 1964–1965 IN THE TIME SERVICE OF THE LATVIAN STATE UNIVERSITY L. Roze p 38–48 refs (See N68-14924 05-30)

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5. ABOUT SOME ERRORS OF THE PHOTOELECTRIC DEVICE OF THE ASTRONOMICAL OBSERVATORY OF THE LATVIAN UNIVERSITY K. Steins and E. Kaupusa p 79–95 refs (See N68-14926 05-14)

6. ABOUT THE THEORY OF LAG OF PHOTOELECTRIC DEVICE FOR REGISTRATION OF STAR TRANSIT K. Steins and E. Kaupusa p 95–119 refs (See N68-14927 05-30)

7. THE INFLUENCE CAUSED BY THE INCLINATION OF THE SLITS OF GRATING ON THE REGISTRATION OF STAR TRANSITS L. Roze p 121–130 ref (See N68-14928 05-30)

8. ABOUT FALSE SIGNALS OF THE PHOTOELECTRIC DEVICE AT THE ASTRONOMICAL OBSERVATORY OF THE LATVIAN STATE UNIVERSITY K. Steins and I. Rungaine p 131–133 ref (See N68-14929 05-30)

N68-14922 Latvian P. Stuchka State Univ., Riga.
ABOUT INVESTIGATIONS OF IRREGULARITIES OF THE EARTH'S ROTATION AT THE ASTRONOMICAL OBSERVATORY OF P. STUCKA LATVIAN STATE UNIVERSITY
K. Steins *In its* Earth's Rotation Irregularities 1967 p 3–31 refs In RUSSIAN; ENGLISH summary (See N68-14921 05-30)

Operational tasks at the Time Services Facility of the Latvian State University Astronomical Laboratory are defined. Within the national time services network, the facility is specifically responsible for: (1) providing time checks based on astronomical observations; (2) studying annual velocity variations in earth rotation cycles; and (3) devising methods and equipment for use in time service laboratories. Improvements in the instrumentation installed at the facility since its opening in 1923 are reviewed. Effects of instrument, data processing, and transmission reception errors are discussed. Procedures introduced to ensure precise observations at the facility are cited, and the effects of irregularities in the earth's rotation are examined. Transl. by E.C.

N68-14924 Latvian P. Stuchka State Univ., Riga.
INVESTIGATION OF THE SYSTEM OF OBSERVATIONS DURING THE YEARS 1964–1965 IN TIME SERVICE OF THE LATVIAN STATE UNIVERSITY
L. Roze *In its* Earth's Rotation Irregularities 1967 p 38–48 refs In RUSSIAN; ENGLISH summary (See N68-14921 05-30)

A transit instrument with a photoelectric assembly installed at the Latvian State University Time Services Facility is discussed. In 1964, the instrument was operated 82 nights recording time calculations derived from 2362 stellar transits; in 1965, 1763 transits were observed during 65 nights of operation. Methods used in processing the time observations and adjusting time measurement instruments are described. It is shown that time checks based on right ascension data contained in the reference document F678 yield the most accurate results. Transl. by E.C.

N68-14925 Latvian P. Stuchka State Univ., Riga.
AN ARTIFICIAL STAR EQUIPMENT FOR DETERMINATION OF THE LAG OF PHOTOELECTRIC DEVICE
K. Steins, K. Cirulis, and E. Kaupusa *In its* Earth's Rotation Irregularities 1967 p 49–78 refs In RUSSIAN; ENGLISH summary (See N68-14921 05-30)

Description and theory of an artificial star is given. This equipment consists of a light source, which moves uniformly by means of a micrometric screw. When the micrometric screw rotates its index fixes the position of the light source with the help of time impulses. The regularity of motion of the light source is dependent on the errors of the gear wheels. A method is elaborated for studying errors of the gear wheels that is analogous to methods used for studying errors of circle divisions in astrometry. The errors of the gear wheels do not exceed 0.006 of a time second. To obtain a clear picture of integral accuracy, impulses of light were photographed and measured when the light source moved uniformly. Author

N68-14927 Latvian P. Stuchka State Univ., Riga.
ABOUT THE THEORY OF LAG OF PHOTOELECTRIC DEVICE FOR REGISTRATION OF STAR TRANSIT
K. Steins and E. Kaupusa *In its* Earth's Rotation Irregularities 1967 p 95–119 refs In RUSSIAN; ENGLISH summary (See N68-14921 05-30)

Time lag of a photoelectric device was calculated, considering the temperatures of stars, the absorption in the atmosphere, optical wavelength, the spectral sensitivity of the photoelectric multiplier, the secondary spectrum of the objective, the velocity of the diurnal motion of stars, and the position of the grating plate. The calculated results of time lag show good agreement with data obtained with artificial star equipment. Author

N68-14928 Latvian P. Stuchka State Univ., Riga.
THE INFLUENCE CAUSED BY THE INCLINATION OF THE SLITS OF GRATING ON THE REGISTRATION OF STAR TRANSITS
L. Roze *In its* Earth's Rotation Irregularities 1967 p 121–130 ref In RUSSIAN; ENGLISH summary (See N68-14921 05-30)

Reasons for mutilations in the observed star transits were studied in connection with inclination of the grating slits. The following was found: (1) Errors committed at the moments of registration by bending of the tube and finder do not influence clock adjustments but do influence the azimuth of the instrument. (2) Errors resulting from the curvature of the parallel of the observed star can be eliminated by fixing the star strictly according to prescriptions. (3) The inclination of the horizontal threads of the finder may cause serious systematic errors in observations. Author

N68-14929 Latvian P. Stuchka State Univ., Riga
ABOUT FALSE SIGNALS OF THE PHOTOELECTRIC DEVICE AT THE ASTRONOMICAL OBSERVATORY OF THE LATVIAN STATE UNIVERSITY
K. Steins and I. Rungaine *In its* Earth's Rotation Irregularities 1967 p 131–133 ref In RUSSIAN; ENGLISH summary (See N68-14921 05-30)

To assess the reliability of astronomical time observations obtained with a photoelectric transit device, the effect of recording errors on the accuracy of clock adjustments was studied. Clock adjustment recording errors were computed with and without weighted functions. It was found that adjustment errors were greater for weighted calculations of recordings of those stars which gave off multiple imprints. Transl. by E.C.

N68-14941*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
GEMINI SUMMARY CONFERENCE
Washington 1967 335 p refs Conf. held at NASA. Manned Spacecraft Center, 1–2 Feb. 1967
(NASA-SP-138) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Gemini program highlights are presented, and flight results are discussed in terms of space orbital maneuvering, extravehicular activities, operational experiences, and onboard experiments. For individual titles, see N68-14942 through N68-14962.

N68-14942*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SUMMARY OF RENDEZVOUS OPERATIONS
W. Bernard Evans and Marvin R. Czarnik (McDonnell Aircraft Corp.) *In its* Gemini Sum. Conf. 1967 p 7–19 ref (See N68-14941 05-30)

Summarized are rendezvous techniques which were evaluated during the Gemini Program and used in the completion of ten rendezvous operations. The following types of techniques were evaluated: fourth orbit (M = 4), third orbit (M = 3), first orbit (M = 1), optical rendezvous, rendezvous from above, stable orbit rendezvous, and optical dual rendezvous. Discussed are approaches used in the development of the operational rendezvous missions, initial rendezvous operations, rendezvous techniques used on Gemini IX-A and Gemini XII, re-rendezvous and dual rendezvous operations, and primary factors (launch procedures, system requirements, and crew procedures) which were considered in the development of rendezvous missions. It is concluded that: (1) The rendezvous operations conducted on Gemini have demonstrated that rendezvous is operationally feasible with an active or a passive target. (2) The Gemini series of missions (VI-A to XII) demonstrated that the operation can be performed using only onboard guidance information after lift-off; using only ground supplied information; or by using a combination of onboard and ground supplied information. S.C.W.

N68-14943*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
GROUND CONTROL AND MONITORING OF RENDEZVOUS
Edward L. Pavelka, Edgar C. Lineberry, and Warren J. Kennedy (Lockheed Missiles and Space Co.) *In its* Gemini Sum. Conf. 1967 p 21–25 (See N68-14941 05-30)

Presented is a discussion of the ground control and monitoring function performed in support of the Gemini rendezvous missions. The support philosophy adopted for Gemini focused on the development of a flexible ground system (having a real time mission planning capability) which would permit the flight control team to react to anomalous situations routinely, while still preserving standardized conditions for the terminal phase rendezvous. This capability consisted of computer driven displays which allowed the flight controllers to assess current conditions, and to select a maneuver sequence compatible with mission constraints. In effect, the role of the flight controllers was to provide a series of midcourse maneuvers which achieved a particular relative separation and velocity between the spacecraft and the target vehicle. Following the final midcourse maneuver, the role changed to monitoring the onboard computed intercept maneuver and the final terminal phase operations. The influence of these concepts on the design of primary rendezvous missions (VI-A to XII) is discussed, and comparative data on predicted and actual flight results are summarized. S.C.W.

N68-14944*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ONBOARD OPERATIONS FOR RENDEZVOUS
Paul C. Kramer, Edwin E. Aldrin, and William E. Hayes (McDonnell Aircraft Corp.) *In its* Gemini Sum. Conf. 1967 p 27–40 (See N68-14941 05-30)

Described are onboard operations for the Gemini rendezvous missions which were designed to make optimum use of crew time in orbit to maximize the probability of a successful rendezvous. Considered are primary operations consisting of crew tasks necessary to define and execute any given maneuver; the monitoring and backup operations which were used to assess the operation of the system and to complete the mission in contigency situations. Discussed are these basic operations as they apply to a general rendezvous mission, and rendezvous operations on the following specific missions: (1) rendezvous in second, third, and fourth orbits; rendezvous in the first orbit; rendezvous from above the target vehicle; rendezvous with a passive target; and stable orbit rendezvous. S.C.W.

N68-14953*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
CONTROLLED REENTRY
David M. Box, Jon C. Harpold, Steven G. Paddock (McDonnell Aircraft Corp.), Neil A. Armstrong, and William H. Hamby *In its* Gemini Sum. Conf. 1967 p 159–166 (See N68-14941 05-30)

Presented is a brief description of two sets of reentry guidance logic, and a detailed description of the results obtained from each Gemini spacecraft reentry. The two reentry techniques analyzed were a rolling reentry technique and a constant bank angle technique. Both techniques provided steering commands based upon a logical assessment of current and predicted energy conditions. Significant results of these studies are as follows: (1) The use of the constant bank angle guidance technique was dependent on an accurate estimate of maneuver capability; therefore, it was ineffective for a mission of long duration where a large center of gravity variation was present or where spacecraft aerodynamic characteristics were uncertain, as on Gemini VII. (2) The rolling reentry guidance technique did not require a knowledge of the spacecraft lift capability and therefore steered to a particular target as long as that target was within the footprint. (3) Displays had to be provided so that the crew could evaluate the performance of the guidance and navigation system, and backup procedures had to be developed to assure safe reentry and accurate landing in the event of a guidance system failure. (4) Consistently accurate navigation could be accomplished during reentry because of a navigation system design which performed adequately in the presence of expected inertial-measurement-system uncertainties. (5) Reentry of the Gemini spacecraft was successfully controlled both manually and automatically. S.C.W.

N68-14959*# National Aeronautics and Space Administration, Washington, D. C.
SCIENCE EXPERIMENTS SUMMARY
Jocelyn R. Gill and Willis B. Foster *In* NASA. Manned Spacecraft Center Gemini Sum. Conf. 1967 p 291–305 refs (See N68-14941 05-30)

Results of scientific experiments conducted during the Gemini X, XI, and XII missions; are reported. Examined are terrain and weather photography experiments; biological experiments; visual acuity experiments; astronomical photography experiments; micrometeorite, cosmic ray, and ion wake experiments; and ultraviolet photography experiments. S.C.W.

N68-14960*# Air Force Systems Command, Los Angeles, Calif. Space Systems Div.
DOD/NASA GEMINI EXPERIMENTS SUMMARY
Wilbur A. Ballentine *In* NASA. Manned Spacecraft Center Gemini Sum. Conf. 1967 p 307–317 (See N68-14941 05-30)

Department of Defense and NASA generated experiments in support of the Gemini Program are summarized. Examined are experiments in the following areas: basic object photography; nearby object photography; mass determination; celestial radiometry; star occultation navigation; surface photography; space object radiometry; radiation in spacecraft; simple navigation; ion sensing attitude control; astronaut maneuvering unit; astronaut visibility; UHF/VHF polarization measurements; night image intensification; and power tool feasibility. S.C.W.

N68-14962*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
GEMINI RESULTS AS RELATED TO THE APOLLO PROGRAM
Willis B. Mitchell, Owen E. Maynard, and Donald D. Arabian *In its* Gemini Sum. Conf. 1967 p 329–336 (See N68-14941 05-30)

Significant contributions of the Gemini Program to future Apollo missions are discussed. The objectives of the Gemini Program applicable to Apollo were: (1) long duration flight, (2) rendezvous and docking, (3) post-docking maneuver capability, (4) controlled reentry and landing, (5) flight and ground crew proficiency, and (6) extravehicular capability. The achievement of these objectives provided operational experience and confirmed much of the technology which will be utilized in future manned programs. Some of the more significant contributions in the following areas are discussed: launch and flight operations, flight crew operations and training, and technological development of subsystems and components. It is concluded that probably the most significant contributions of the Gemini Program were the training of personnel and organizations in the disciplines of management, operations, manufacturing, and engineering. S.C.W.

N68-15000 Lockheed Missiles and Space Co., Sunnyvale, Calif.
GLIDING DESCENT
M. K. Tikhonravov, I. M. Iatsunskii, G. Iu. Maksimov, I. K. Bazhinov, and O. V. Gurko [1967] 15 p Transl. into ENGLISH from the book "Principles of the Theory of Flight and Elements of Projections of Artificial Earth Satellites" Moscow, Mashinostr., 1967 p 82–98

An approximation method is used to perform least heating analyses for gliding descents of piloted vehicles by computing that

fundamental portion of the flight trajectory in the dense layers of the atmosphere in which the greatest deceleration of the motion velocity occurs. It is assumed that the ratio between the energy going into heating the vehicle and the drag is constant and that the heat is uniformly distributed to the vehicle over the whole trajectory. Results for the gliding descent of a satellite with low aerodynamic quality show that the time of descent increases radically as the quality rises; overload and temperature peak increases stretch the time of descent and thus vehicle heating. The most significant effect of the overload is exerted by the reentry angle. A fast descent is achieved for a -3° reentry angle. G.G.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-13972# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ROCKETS OF PEACE AND WAR

V. P. Petrov 18 Aug. 1967 137 p refs Transl. into ENGLISH of the book "Rakety Mira i Voiny" Moscow, 1963 p 1–172
(FTD-MT-65-175; AD-661885)

The book discusses the physical fundamentals of jet propulsion, multistage carrier rockets, satellites, space rockets and ships, and also the perspectives of their development. It considers the problems of launching a satellite into orbit and the methods of orientating them in free flight; classifications and brief descriptions are given of the main types of contemporary American ballistic rockets and satellites for various purposes; a number of projects are mentioned on antimissile defense, interception satellites, reconnaissance satellites, navigation satellites, and satellites to be utilized for world-wide communications. Furthermore, the book discusses the feasibilities of effectively using ballistic and space rockets for peaceful purposes. Examples are given of the application of these rockets in meteorology, astronomy, geodesy, and cartography, for investigating terrestrial mineral resources, world-wide television broadcasting, communications, etc. All the numerical and factual material, and also the data on fuel, are presented according to information in the foreign press. TAB

N68-14016# European Space Vehicle Launcher Development Organization, Paris (France).

THOR DELTA LAUNCH VEHICLES [LES "THOR DELTA"]

M. Gilli 1967 31 p In FRENCH
(ELDO-TM-106) CFSTI: HC $3.00/MF $0.65

Describes the different types of the Thor Delta vehicles, their design characteristics, performance data and relevant space missions up to-date, and gives an outline of future improvements. Author (ESRO)

N68-14058 Lockheed Missiles and Space Co., Sunnyvale, Calif.

THE METEOR SPACE SYSTEMS

I. Vetlov [1967] 8 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 9, 1967 p 31–35

The development of the meteorological satellite system leading to the Cosmos-156 launching is outlined, and the instrumentation and power system are briefly described. Improvements and modifications in equipment were indicated from tests on satellites launched previously in the program. Television apparatus for observing daytime cloudiness, infrared apparatus for determining nighttime radiation flux, and actinometric instruments for measuring departing radiation flux are mentioned. N.E.N.

N68-14092*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PERFORMANCE OF A 16.6-METER-DIAMETER MODIFIED RINGSAIL PARACHUTE IN A SIMULATED MARTIAN ENVIRONMENT

Charles H. Whitlock, Allen B. Henning, and Lucille C. Coltrane Washington Jan. 1968 39 p refs Film Supplement Number L-984 is Available on Loan from NASA Langley Research Center
(NASA-TM-X-1500) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Inflation, drag, and stability characteristics of a 54.5-foot nominal-diameter (16.6-meter) modified ringsail parachute deployed in the wake of a 15-foot-diameter (4.6-meter) spacecraft traveling at a Mach number of 1.6 and a dynamic pressure equal to 11.6 psf (555 N/m^2) were obtained from the third balloon-launched flight test of the Planetary Entry Parachute Program. After deployment, the parachute inflated rapidly to a full condition, partially collapsed, and reinflated to a stable configuration. After reinflation, an average drag coefficient near 0.6 based on nominal surface area was obtained. During descent, an aerodynamic trim angle was observed in a plane near several torn sails. Amplitude of the trim was approximately 15° and oscillation about trim was less than 11°. Author

N68-14197* Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

SPACE RESEARCH IN 1966 [KOSMICHESKIYE ISSLEDOVANIYA 1966 G]

A. A. Blagonravov and Yu. I. Zaytsev Washington NASA Jan. 1968 14 p ref Transl. into ENGLISH from Vestn. Akad. Nauk. SSSR (Moscow), no. 10, 1967 p 63–73
(Contract NASw-1692)
(NASA-TT-F-11465) CFSTI: $3.00 CSCL 22B

This article is primarily a review of the accomplishments of the Soviet Union in space research since 1957, involving the satellite series "Lunar", "Zond", "Molniya", "Proton", and "Cosmos". Comparisons are made based on data from the various probes and a brief description is given of the lunar surface from measurements employing penetrometers, dynamographs, radiation densimeters and gas-discharge counters. Brief mention is made of the medico-biological research being conducted and its applicability to the discovery of extraterrestrial life and the functioning of space crews in flight. Further research is being conducted relative to the forecasting of weather conditions and the use of satellites as communication links. Author

N68-14215* Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

THE HOMELAND OF ASTRONAUTICS [RODINA KOSMONAVTIKI]

G. V. Petrovich Washington NASA Jan. 1968 13 p Transl. into ENGLISH from Vestn. Akad. Nauk. SSSR (Moscow), no. 10, 1967 p 54–62
(Contract NASw-1692)
(NASA-TT-F-11454) CFSTI: $3.00 CSCL 22A

This article reviews the accomplishments of the USSR in the field of astronautics. Weights, specific thrust and lifting capacity are mentioned for several of the rocket-carriers. Names of several formations on the dark side of the Moon have been assigned by the Academy of Sciences, USSR. The names of the Soviet astronauts are listed and mention is made of the death of the American and Soviet astronauts. Emphasis is placed on the peaceful purposes of the Soviet space program. Author

N68-14363* Boeing Co., New Orleans, La. Launch Systems Branch.

HYDROGEN EXPLOSION HAZARD SURVEY OF THE S-IC STAGE FORWARD SKIRT SECTION

A. L. Schell and J. E. Nye [1967] 79 p
(Contract NAS8-5608)
(NASA-CR-61421; D5-13693) CFSTI: $3.00 CSCL 22D

All electrical and electro-mechanical components located inside the forward skirt section (Unit 120) of the stage are listed, including interconnect cabling. Based on packaging, enclosure, purge capability, time of operation, and assuming a hydrogen/oxygen gas environment, each component is evaluated as safe, satisfactory, acceptable or unsatisfactory applicable. This document contains the Hydrogen Explosion Hazard Survey for the S-1C-3 and S-1C-4 stages in flight (J) configuration. Author

N68-14617*# Northrop Corp., Hawthorne, Calif. Systems Labs.
ORBITING EXPERIMENT FOR STUDY OF EXTENDED WEIGHTLESSNESS. VOLUME 1: SUMMARY
Dec. 1967 53 p refs
(Contract NAS1-6971)
(NASA-CR-66507; NSL-67-300, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The results of a definition study of a spacecraft system to support two primates in unattended, weightless, earth-orbital flight for extended periods of time are summarized. The experiment is planned as part of the Apollo Applications Program; the spacecraft launched as a LEM substitute on an AAP flight; the primates recovered by astronaut EVA on a later flight and returned to earth in retrieval canisters within the command module. Intensive post-flight examination is planned to ascertain even subtle physiological changes in the primates due to their extended exposure to weightlessness. The study includes definition of mission profile and Apollo Applications Program interfaces, preliminary design of the spacecraft, and planning for subsequent phases of the program. Author

N68-14635* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ATM ATTITUDE CONTROL SYSTEM
Willard W. Anderson 11 Aug. 1967 33 p refs Presented at the SAE A-18 Comm. Meeting, Boston, 9–11 Aug. 1967
(NASA-TM-X-60800) CFSTI: $3.00 CSCL 22B

The basic Apollo Telescope Mount (ATM) Cluster configuration and attitude control system are defined. Logic flow within the control system is discussed. Emphasis is placed on defining the nature of the interaction between the flexible cluster and the control system. Data from a digital simulation of the cluster and control system are presented. These data substantiate a design approach which provides control system damping and stiffness for the flexible cluster modes in addition to the rigid cluster modes. The present design provides control for the rigid cluster modes only. Author

N68-14638* General Motors Corp., Santa Barbara, Calif.
EXPERIMENTAL INVESTIGATIONS OF SIMULATED METEOROID DAMAGE TO VARIOUS SPACECRAFT STRUCTURES
A. R. McMillan Washington NASA Jan. 1968 145 p refs
(Contract NAS9-3081)
(NASA-CR-915; TR-66-67) CFSTI: $3.00 CSCL 22B

A theoretical and experimental program has been performed to evaluate high-velocity impact damage to structures composed of two thin metallic sheets spaced some distance apart. The results of this study are applicable to the impact of meteoroids against space vehicles. A hydrodynamic treatment, combined with experiments, shows that the damage mechanisms to be considered for the second sheet are gross deformation, tensile failure, and spallation. Gross deformation and tensile failure were treated with a blast-loaded thin-shell analysis, and spallation with a two-dimensional elastic–plastic treatment. Multisheet (more than two simple sheets) structures were also analyzed and found to provide less protection within the same total structural thickness and weight than two-sheet structures. Honeycombs between the two sheets were found to be detrimental to the impact resistance of two-sheet structures. An analysis was also performed to assess the area-time of exposure for a 0.99 probability of no failure. This analysis is presented. Author

N68-14679*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 7, NUMBER 16
31 Aug. 1967 33 p
(NASA-TM-X-60794; X-512-66-51, V. 7, No. 16) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Observation data on satellites are tabulated. The data includes the code name, originating country, launching date, period, inclination, apogee, perigee, and transmitting frequency. N.E.N.

N68-14785 Joint Publications Research Service, Washington, D. C.
RESULTS OF SPACE RESEARCH WITH THE KOSMOS-149
G. V. Rozenberg, M. S. Malkevich, A. M. Kasatkin, and Yu. I. Zaytsev 16 Jan. 1968 9 p Transl. into ENGLISH from Priroda (Moscow), no. 9, Nov. 1967 p 69–72
(JPRS-44029) CFSTI: $3.00

Research equipment used aboard the Cosmos 149 satellite during flight is described. Telephotometers, infrared radiometers, television, and radio telemetry were used to gather data on reflected solar, cosmic, and terrestrial radiation. Vapor pressures in the atmosphere were also monitored. The general design of the Cosmos 149, and the arrangement of the apparatus within the airtight hull, are schematically drawn. The stability of the spacecraft during flight is discussed. L.S.

N68-14890*# Northrop Corp., Hawthorne, Calif. Systems Labs.
ORBITING EXPERIMENT FOR STUDY OF EXTENDED WEIGHTLESSNESS. VOLUME 3: SPACECRAFT PRELIMINARY DESIGN
Dec. 1967 317 p refs
(Contract NAS1-6971)
(NASA-CR-66509; NSL-67-300, V. 3) CFSTI: HC $3.00/MF $0.65 CSCL 22B

To achieve an optimum balance between reliability, performance, compatibility with the Saturn/Apollo Applications Program, and hardware constraints and cost, maximum use was made of proven techniques and equipment consistent with the criteria for the Orbiting Primate Spacecraft (OPS). Intended as a LEM substitute to accommodate two primates in earth orbit for up to a year, the OPS configurations are discussed in terms of the functional characteristics, and the interrelationships between the various elements of the spacecraft and between the spacecraft and its interfaces with the launch vehicle. The direct interactions and interdependency of the various spacecraft subsystems and the primate are also considered. Detailed descriptions are provided on the subsystems for such functional areas as life support, thermal control, structure and mechanical, instrumentation, telemetry, command and control, electric power and cabling, and attitude control. Basic dimensions for the baseline spacecraft design are given, reaction equations are derived, orbit transfer loads are analyzed, and transducer comparison data are tabulated. M.G.J.

N68-14891*# Northrop Space Labs., Hawthorne, Calif. Systems Labs.
ORBITING EXPERIMENT FOR STUDY OF EXTENDED WEIGHTLESSNESS. VOLUME 4: LABORATORY TEST MODEL

Dec. 1967 91 p
(Contract NAS1-6971)
(NASA-CR-66510; NSL-67-300, V. 4) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Performance requirements, proposed design and construction, and operation test procedures are described for the laboratory test model of the Orbiting Primate Spacecraft. The test mode will provide accurate scaling factor data for oxygen, food and water usage, and also information concerning contamination control and waste management within a closed environmental control system. The life support, thermal control, structural and mechanical, instrumentation, and command and control subsystems are described in detail. Test plans and procedures are given for the operational testing of the model. B.S.D.

N68-14892*# Northorp Corp., Hawthorne, Calif. Systems Labs.
ORBITING EXPERIMENT FOR STUDY OF EXTENDED WEIGHTLESSNESS. VOLUME 5: PROGRAM PLANS
Dec. 1967 399 p
(Contract NAS1-6971)
(NASA-CR-66511; NSL-67-300, V. 5) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Program plans are presented to document the future activity for designing, developing, fabricating, and delivering an Orbiting Primate Spacecraft (OPS) for a late 1970 launch. The master plan comprises two phases. The Phase 2 planning approach is to define and establish a baseline design for spacecraft system requirements; design, fabricate, checkout, and deliver a laboratory test model; and define the final project concept, including system design and breadboarding of critical subsystems. The laboratory test model program is to be directly coordinated with, but not encompassed within, Phase 2. Phase 3 is to include design, completion, fabrication, checkout, qualification, and delivery of an OPS. Estimated time span from go-ahead to spacecraft flight readiness is established at 29 months. Also included are detailed procedures on management, experiment, and engineering plans; integrated test programs; reliability and quality assurance plans; and a manufacturing plan. M.G.J.

N68-14893*# Northorp Corp., Hawthorne, Calif. Systems Labs.
ORBITING EXPERIMENT FOR STUDY OF EXTENDED WEIGHTLESSNESS. VOLUME 6: ORBITING PRIMATE SPACECRAFT APPLICATIONS
Dec. 1967 89 p
(Contract NAS1-6971)
(NASA-CR-66512; NSL-67-300, V. 6) CFSTI: HC $3.00/MF $0.65 CSCL 22B

As part of the Apollo Application Program (AA), a definition study was conducted on an orbiting primate spacecraft to determine its versatility in conducting a variety of engineering and biological experiments. Details are given on the spacecraft configuration which is a functionally integrated unit designed for use on a lunar excursion module companion or substitute payload with a self-sustaining capability of six months to one year. Interest is centered on the prime experiment of placing two primates in unattended, extended duration, zero gravity earth orbit. In addition, several biological experiments are described, along with the data and control requirements, operational goals, and the necessary modifications to the spacecraft design. An engineering experiment involved the performance assessment of a carbon dioxide management system. Conceptual approaches for integrating the spacecraft with the S/AAP orbiting laboratory are discussed, and alternate mission modes are developed. M.G.J.

N68-14945*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
OPERATIONAL CHARACTERISTICS OF THE DOCKED CONFIGURATION
Homer W. Dotts, Roger K. Nolting (McDonnell Aircraft Corp.), Wilburne F. Hoyler, John R. Havey (McDonnell Aircraft Corp.), Thomas F. Carter et al *In its* Gemini Sum. Conf. 1967 p 41–54 (See N68-14941 05-30)

Summarized are results of studies designed to develop a docking maneuver to join the Gemini spacecraft and the target vehicle as a single spacecraft configuration; to evaluate the characteristics of the control system on each vehicle in controlling the combined vehicle; and to use the primary propulsion system of the target vehicle to enlarge the manned spacecraft maneuvering capability. From the experience in the Gemini Program relative to the operational characteristics of the docked configuration, the following significant conclusions were apparent: (1) The maneuvering and subsequent docking of spacecraft in orbit is practical and, when a proper design exists, is a relatively easy task. (2) The joining of manned vehicles to unmanned craft containing large propulsion units can provide large maneuver capability where launch payload constraints prevent a combined launch. (3) The development of docking and docked maneuvers of the Gemini spacecraft and the Gemini Agena target vehicle is an example of engineering success since no prior technology was available. S.C.W.

N68-14946*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
OPERATIONS WITH TETHERED SPACE VEHICLES
David D. Lang and Roger K. Nolting (McDonnell Aircraft Corp.) *In its* Gemini Sum. Conf. 1967 p 55–64 (See N68-14941 05-30)

Presented is a discussion of two modes of tethered space vehicle operations that were explored in the Gemini Program. One mode of operation consisted of intentionally inducing an angular velocity in the tethered system by translational thrusting with the spacecraft propulsion system. The other mode involved tethered, drifting flight during which the effect of gravity gradient on the motion of the system was emphasized. The following are considered for each mode of operation: supporting analytical studies, operational procedures, crew training, and flight results. S.C.W.

N68-14954*# Air Force Systems Command, Los Angeles, Calif. Space Systems Div.
LAUNCH AND TARGET VEHICLE SUPPORT BY THE DEPARTMENT OF DEFENSE
Alfred J. Gardner *In* NASA. Manned Spacecraft Center Gemini Sum. Conf. 1967 p 167–184 refs (See N68-14941 05-30)

Summarized are Department of Defense launch and target vehicle technical support for the Gemini Program. Described are highlights of Air Force technical support in the management and development of: (1) the Gemini launch vehicle which is a modified Titan II intercontinental ballistic missile; (2) the Gemini Agena Target Vehicle which is a modified Agena upperstage booster; and (3) the launch vehicle for the target vehicle, which is a modified Atlas standard launch vehicle (SLV-3). Included is an overview of the Gemini Atlas–Agena target vehicle launch history. S.C.W.

N68-14957*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
GEMINI EXPERIMENTS PROGRAM SUMMARY
Norman G. Foster and Olav Smistad *In its* Gemini Sum. Conf. 1967 p 221–230 refs (See N68-14941 05-30)

Summarized are scientific, technological, and medical experiments which were conducted during the Gemini Program. Included are descriptions of principal investigators and affiliations; experiment equipment integration; crew integration; mission planning; prelaunch operations; real time mission support; and experimental performance. S.C.W.

N68-14965*# National Aeronautics and Space Administration, Washington, D. C.
SCIENTIFIC SATELLITES
William R. Corliss 1967 828 p refs
(NASA-SP-133) GPO: $3.00 CSCL 22B

A detailed compilation of the equipment and instrumentation of scientific satellites is presented, along with the history, status, and objectives of satellite science. Satellite systems described include navigation, guidance and control, communication and data handling equipment, and subsystem integration. Earth-based facilities and operations are also considered. The role of satellite dynamics is assessed, and launch vehicle and satellite design data are given. Various aspects of satellite science are discussed in terms of the geophysical and solar physics instruments, biological experiments, and the experiments associated with satellite astronomy. A bibliography of engineering reports is included. B.S.D.

N68-14978*# Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div
DETERMINATION OF OPTICAL TECHNOLOGY EXPERIMENTS FOR A SATELLITE, PHASE 1 Engineering Report No. 7846, Jul.–Nov. 1964
Nov. 1964 380 p refs
(Contract NAS8-11408)
(NASA-CR-61441) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The purpose of this study is to recommend a set of earth satellite experiments which will best advance the development of optical technology in space. Considerations are limited to optical communication and closely related aspects of optical astronomy and optical scientific instrumentation in space. Recommendations are given for atmospheric effects experiments, an eye–hand loop experiment, heterodyne experiments, tracking and acquisition experiments, and the communications and optics technology experiments. Included are orbital and reflector studies and communications systems are probability formulas. K.W.

N68-15004*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37–48, VOLUME 1 FOR THE PERIOD SEPTEMBER 1 TO OCTOBER 31, 1967. FLIGHT PROJECTS
30 Nov. 1967 95 p refs
(Contract NAS7-100)
(NASA-CR-91775; JPL-SP-37-48, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22B

During the September–October reporting period the Mariner 4 spacecraft was transferred to the roll inertial attitude control mode and reoriented so that the high gain antenna was positioned toward the earth and the ground received signal increased. A successful firing of its midcourse motor provided a great amount of engineering data, and an additional rate change to 8-1/3 bits enabled the video storage system to transmit Mars pictures back to earth. Preliminary scientific data from a Venus encounter phase of 2543 mi. established definite evidence for the interaction of solar wind with Venus and the absence of energy particles or radiation belts. Several alternate plans for Mars flyby missions in 1969 were studied by variable mission analyses. All Voyager interplanetary missions were canceled; scientific efforts performed prior to close-out were briefly outlined. Results of four Surveyor VI Lunar missions in support of the Apollo manned lunar landing program were also included. During these missions many lunar pictures were returned and alpha scattering experiment data obtained. G.G.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-13942* California Univ., Berkeley.
ANALYSIS OF ELASTIC-PLASTIC SHELLS OF REVOLUTION
M. Khojasteh-Bakht and E. P. Popov 10 Nov. 1967 6 p refs Presented at Am. Soc. of Civil Engr. Specialty Conf. on the Discrete and Continuum Concepts in Micro and Macro Mech., N. C. State Univ., Raleigh, 8–10 Nov. 1967
(Grant NsG-27-S2)
(NASA-CR-91682) CFSTI: $3.00 CSCL 20K

A finite element approach using a displacement model is employed to analyze the behavior of elastic-plastic shells of revolution under axisymmetrical loading. The basis for establishing a new curved element which satisfies the compatibility of slopes and curvatures at nodal circles is described. Methods of solution for the elastic-plastic problem using the tangent stiffness and the initial strain approaches are presented and compared. The superiority of the first method is pointed out. Author

N68-13943*# Lehigh Univ., Bethlehem, Pa. Dept. of Applied Mechanics.
EXTERNAL ELLIPTICAL CRACK IN ELASTIC SOLID
M. K. Kassir (City Coll. of the City of New York) and G. C. Sih Nov. 1967 20 p refs
(Grant NGR-39-007-025)
(NASA-CR-91667; TR-2) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Potential functions are developed for both symmetric and antisymmetric three-dimensional problems of an infinite elastic solid containing a flat crack covering the outside of an ellipse. The knowledge of these functions permits an examination of the stress and displacement fields everywhere in the cracked solid as well as in a toroidal region around the crack border. Stress-intensity factors corresponding to the three basic modes of fracture are obtained. The results of this paper, coupled with those found previously by the authors for the problem of internal elliptical crack, are essential in making approximate estimates of k_j-values for solids with arbitrarily-shaped planar cracks. Author

N68-13962* General Electric Co., Philadelphia, Pa. Missiles and Space Div.
DESIGN CRITERIA AND CONCEPTS FOR FIBROUS COMPOSITE STRUCTURES Annual Report
Norris F. Dow, B. Walter Rosen, Larry S. Shu, and Carl H. Zweben Jul. 1967 194 p refs
(Contract NASw-1377)
(NASA-CR-66518) CFSTI: $3.00 CSCL 20K

The results of a program to study the analysis and design of composite materials and structures is reported. Emphasis was placed upon three major areas: the definition of design criteria for laminates including studies of basic failure mechanisms; the definition of unique design concepts to enhance the beneficial characteristics of composite materials and to utilize them in structures; and the analysis of composite materials property test techniques. Author

N68-13965* General Electric Co., King of Prussia, Pa. Space Sciences Lab.
AN EQUATION OF STATE FOR SOLIDS BASED ON A MODIFIED PLATE-GAP MODEL
James F. Heyda [1965] 6 p refs
(Contract NAS3-8512)
(NASA-CR-91675) CFSTI: $3.00 CSCL 20K

By coupling a basic equation for the crush-up wave velocity in a porous solid with a second equation which incorporates conservation of momentum across the crush-up front, an analytical formulation is obtained which checks closely the available experimental Hugoniot data for solids of varying initial porosity. For each such porosity the formulation yields a curve lying on the equation of state surface of the given material. A full equation of

state surface in the form P = P(V, E) can then be written by defining the latter to be the locus of such curves as the initial porosity is varied. The function P(V, E) is then completely determined once the Hugoniot function is prescribed. Author

N68-13992# Boeing Co., Renton, Wash. Commercial Airplane Div.

A STUDY OF STRESS-CORROSION CRACKING BY WEDGE-FORCE LOADING

Harold R. Smith, Donald E. Piper, and Frank K. Downey Jun. 1967 12 p refs

(Contract N00014-66-C0365; ARPA Order 878)

(D6-19768; AD-661811)

Wedge-force loading a center-cracked sheet specimen provides a unique resolution of whether stress-corrosion cracking (SCC) depends on an applied crack-tip stress-intensity factor or on net-section stresses. With this loading, crack extension causes a decreasing stress-intensity factor at the crack tip, while the net-section stresses increase. Therefore, when stress-corrosion crack growth is arrested in this specimen, the dependency on stress intensity is proved. The stress intensity at arrest agrees remarkably well with K sub SCC values determined by more conventional techniques that establish crack initiation thresholds through multiple tests. Crack growth rate data important to the establishment of inspection intervals in structure can also be obtained. Finally, the technique affords considerable economy of test time and material costs in stress-corrosion studies. Author (TAB)

N68-14091*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INFLUENCE OF DISCRETE RING STIFFENERS AND PREBUCKLING DEFORMATIONS ON THE BUCKLING OF ECCENTRICALLY STIFFENED ORTHOTROPIC CYLINDERS

David L. Block Washington Jan. 1968 70 p refs

(NASA-TN-D-4283) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The buckling of eccentrically stiffened perfect orthotropic cylinders is the subject of an analytical investigation in which prebuckling deformations and the influence of discretely located ring stiffeners are taken into account. By using energy principles, nonlinear prebuckling equations and linear buckling equations are derived. Solutions for simply supported and clamped boundary conditions and for loadings of axial compression and internal or external pressure are obtained by the method of finite differences and a modified Gaussian elimination technique. Computed results for two types of simply supported large-diameter stiffened cylinders loaded in axial compression illustrate the influence on the buckling load of prebuckling deformations, discrete rings, and eccentricity of applied axial compressive loads; results for clamped longitudinally stiffened cylinders are compared with previous test results. The results show that the predicted buckling load may be substantially affected by consideration of prebuckling deformations, eccentric loading, and discreteness of rings and that agreement with experiment may be improved by including these factors. Author

N68-14124 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON WAVE PROPAGATION IN BONDED MEDIA

G. A. Van Fo Fy [1967] 3 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Uk. RSR (Kiev), no. 9, 1967 p 816–818

Numerically determined is the structure of the wave field for elastic wave propagation in an inhomogeneous (bonded) media whose regular structure is produced by fibers arranged at the nodes of a hexagonal or square lattice. S.C.W.

N68-14140 Lockheed Missiles and Space Co., Sunnyvale, Calif.

STATISTICALLY ISOTROPIC DEFORMATION OF COMPOSITE MATERIALS

G. N. Savin and L. P. Khoroshun 1967 4 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Uk. SSR (USSR), Ser. A, no. 9, 1967 p 804–808

Described are methods for determining the macro-modules stress and strain states of an elastic solid for random distributions of inhomogeneities, which remains in the macroscopically homogeneous strain state. Examined is a solid with isotropic constituent parts which is characteristic of bonded materials, and a material bonded by grains or by twisted and randomly directed fibers for which the field of the moduli is statistically isotropic. S.C.W.

N68-14175* Texas Univ., Austin. Dept. of Civil Engineering.

A STUDY OF SOIL-SPACECRAFT INTERACTION DURING IMPACT

Donald R. Reichmuth, Robin P. Stagg, David P. Womack, and William R. Cox Dec. 1966 198 p refs

(Contract NAS9-3559)

(NASA-CR-91690) CFSTI: $3.00 CSCL 20K

The impact behavior of several projectiles was studied, and the important parameters affecting the soil projectile interaction mechanism were defined. This information was correlated with data obtained from prototype drops so that interaction forces could be predicted. The testing apparatus consisted of a truck-mounted track system which could launch projectiles weighing between 30 and 150 pounds at known velocities and at angles ranging from vertical to 30° to the horizontal. Three types of projectile impact surfaces were studied: wedges, cylinders, and spheres. Impact velocities ranged up to 35 feet per second. The impact sites were carefully chosen to set limits on the behavior that could be expected and included poorly-graded sand, well-graded sand, and clay. Also a limited number of water drops were conducted to provide relative data. Over 400 test drops were conducted during which the impact attitude and velocity of the projectile were measured. Four components of projectile acceleration in the plane of motion were also measured during impact. These acceleration records were then analyzed on a high-speed digital computer so that forces, accelerations, velocities, and displacements as a function of time from impact were obtained. Author

N68-14176*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

DESIGN CRITERIA AND CONCEPTS FOR FIBROUS COMPOSITE STRUCTURES Final Report

Norris F. Dow, B. Walter Rosen, Larry S. Shu, and Carl H. Zweben Jul. 1967 195 p refs

(Contract NASw-1377)

(NASA-CR-91728) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The results of a program to study the analysis and design of composite materials and structures are reported. Emphasis was placed upon three major areas: the definition of design criteria for laminates including studies of basic failure mechanisms; the definition of unique design concepts to enhance the beneficial characteristics of composite materials and to utilize them in structures; and the analysis of composite materials property test techniques. Author

N68-14187* Utah Univ., Salt Lake City. College of Engineering.

THE MECHANICS OF FRACTURE IN VISCOELASTIC MEDIA Semiannual Progress Report, May 1–Oct. 31, 1967

M. L. Williams and W. B. Jones 1 Nov. 1967 8 p refs

(Grant NGR-45-003-029)

(NASA-CR-91286; UTEC-DO-67-081) CFSTI: $3.00 CSCL 20K

A study was continued of the phenomenological behavior of cumulative damage fracture in viscoelastic materials through the use of the spherical flaw concept and the preliminary steps were taken toward experimental verification. Kinetic energy considerations were expanded to include a variety of loading conditions. There

now appears a reasonable model based on the energy concept that describes crack velocity as a continuous function of a characteristic time. Details of the experimental approach used are discussed. R.N.A.

N68-14199*# Southwest Research Inst., San Antonio, Tex.
DYNAMICS OF SHELLS Final Report, 16 Mar. 1964–14 Jul. 1967
Ulric S. Lindholm Jul. 1967 18 p refs
(Contract NASr-94(06))
(NASA-CR-91681) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A review of research focusing on determining the vibrational characteristics (both normal modes and natural frequencies) of thin shells; is reported. Specific shell geometries studied included the truncated cone, a joined cone-cylinder, and the complete sphere. Summaries of technical reports and published papers are presented, and fabrication methods used in the construction of thin shell models are discussed. Also reviewed are analytical methods which were developed to solve the eigenvalue problem governing the linear vibration of simple shells of revolution; problems involving flexural vibrations of cones with free edges; methods for calculating the frequencies and mode shapes of ring stiffened, circular cylindrical shells; and methods for analyzing problems concerning the compatibility of the different sets of governing differential equations relating to the different segments of shells composed of segments of different geometry, such as the cone-cylinder. S.C.W.

N68-14211* Texas A&M Univ., College Station. Space Technology Div.
[ANALYSIS OF STRUCTURALLY ORTHOTROPIC SHELLS BY MEANS OF THE COMPLIANCE METHOD] Annual Progress Report, Period Ending 30 Nov. 1967
Thomas J. Kozik 22 Dec. 1967 56 p refs
(Grant NGR-44-001-031)
(NASA-CR-91671) CFSTI: $3.00 CSCL 20K

Studies in the following five areas of research are reported: (1) sandwich shell investigations; (2) experimental verification of shallow shell compliance equations for rib stiffened cylindrical panels; (3) shallow shell compliance calculations; (4) compliance studies for rib stiffened circular cylindrical shells; and (5) nonlinear shell equation studies. Sandwich shell studies which focused on the effects of normal and shear stresses on core were completed and equations, based on second order approximation shell theory, which describe sandwich shell behavior were developed. Test apparatus for use in the experimental verification of shallow shell compliances is described, and results of initial tests concerned with measuring normal deflections are summarized. A testing program was initiated to determine experimentally shallow rib stiffened cylindrical panel deflections. Objective of this program was to determine the correct relation for membrane rigidities based on comparative experimental and calculated results. To obtain more points for experimental and analytical comparisons on the only available geometry for the rib stiffened cylindrical panel test specimen, the analysis was modified to yield additional calculated deflections at points other than the core of the panel. S.C.W.

N68-14231* Northwestern Univ., Evanston, Ill. Structural Mechanics Lab.
THE USEFULNESS OF ADJOINT SYSTEMS IN SOLVING NONCONSERVATIVE STABILITY PROBLEMS OF ELASTIC CONTINUA
Shyam N. Prasad (Miss. Univ.) and George Herrmann Sep. 1967 15 p refs
(Grants NsG-605; NGR-14-007-067)
(NASA-CR-66538; TR-67-5) CFSTI: $3.00 CSCL 20K

The general linearized problem of stability of equilibrium of an elastic continuum subjected to follower-type surface tractions is formulated and it is indicated how an adjoint system may be constructed. It is proved that the two sets of eigenvalues of the original and adjoint systems are identical and that each member of the set is a stationary value for a variation of the displacement functions. These properties are then exploited to establish an approximate method of stability analysis which is shown to be more powerful than the commonly used Galerkin method. An illustrative example concludes the presentation. Author

N68-14349* Farnham (Frank C.) Co., Philadelphia, Pa.
THEORY OF STABILITY OF THIN ELASTIC HETEROGENEOUS ANISOTROPIC PLATES OF VARIABLE RIGIDITY [K TEORII USTOYCHIVOSTI UPRUGIKH TONKIKH ANIZOTROPNYKH NEODNORODNYKH PLIT PEREMENNOY ZHESTKOSTI]
P. G. Shulezhko Washington NASA Nov. 1967 15 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 6, no. 2–3, 1942 p 139–150
(Contract NASw-1497)
(NASA-TT-F-11346) CFSTI: $3.00 CSCL 20K

This article presents an expression for the total potential energy, the differential equation of the elastic surface of a plate, and the boundary conditions for anisotropic heterogeneous plates with variable rigidity, assuming that the middle surface of the plate is simultaneously the surface of both elastic and geometric symmetry. It is shown that Kirchhoff's boundary conditions for the bending of plates cannot always be extended to the buckling of plates. Author

N68-14371* Aerojet-General Corp., Azusa, Calif. Von Karman Center.
CRYOGENIC BORON-FILAMENT-WOUND CONTAINMENT VESSELS Final Report, May 19–Sep. 30, 1967
E. E. Morris and R. J. Alfring Nov. 1967 67 p refs
(Contract NAS3-10282)
(NASA-CR-72330; Aerojet-3475) CFSTI: $3.00 CSCL 13D

Filament tensile strengths and pressure-strain characteristics for a high-modulus, boron-filament-wound/resin-composite, thin-metal-lined structure were obtained by burst testing 8-in.-dia by 13-in.-long pressure vessels at 75 and −320°F. The average filament tensile strengths obtained were 236,000 psi at 75°F and 273,800 psi at −320°F. The strains at vessel failure were about 0.3 to 0.4%. In addition, fabrication techniques were developed and recommendations were generated for promising areas of development. Author

N68-14403# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ACOUSTIC EMISSION BEHAVIOR OF ZIRCALOY-2 PRESSURE TUBING UNDER APPLIED STRESS
T. E. Michaels and M. C. Fraser Sep. 1967 14 p refs
(Contract AT(45-1)-1830)
(BNWL-545) CFSTI: HC $3.00/MF $0.65

The acoustic emission of Zircaloy-2 pressure tube material was studied during burst tests. Three material conditions were studied: as-received pressure tube material, as-received with addition of 275 ppM hydrogen, and irradiated material. Author (NSA)

N68-14499*# Northwestern Technological Inst., Evanston, Ill. Structural Mechanics Lab.
SOME THEOREMS ON STABILITY OF DISCRETE CIRCULATORY SYSTEMS
Shyam N. Prasad (Mississippi Univ.) and George Herrmann Oct. 1967 15 p refs
(Grants NsG-605; NGR-14-007-067)
(NASA-CR-66537; TR-67-6) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Several theorems pertaining to the stability of discrete, linear, circulatory (i.e., nonconservative) systems are established. One theorem states the condition under which static loss of stability cannot occur. The other theorems are associated with the destabilizing effect of velocity-dependent forces. The usefulness of the new theorems in stability analysis is indicated. Author

N68-14507# Australian National Univ., Canberra. Dept. of Engineering Physics.

MECHANICAL STRESSES IN AN INFINITELY LONG HOMOGENEOUS BITTER SOLENOID WITH FINITE EXTERNAL FIELD

P. O. Carden Jan. 1967 24 p refs

(EP-RR-12)

Equations for the radial and azimuthal principal stresses are derived for the case of an infinitely long solenoid immersed in an externally applied parallel field. The solenoid has a 1/radius or "Bitter" current density distribution and is constructed of homogeneous, isotropic material. A series of computed normalized stress curves is appended, and application to real solenoids of finite length are briefly discussed. Author

N68-14516# Battelle Memorial Inst., Columbus, Ohio.

INVESTIGATION OF THE INITIATION AND EXTENT OF DUCTILE PIPE RUPTURE Quarterly Progress Report, Jul.–Sep. 1967

Robert J. Eiber, Willard A. Maxey, Arthur R. Duffy, and Thomas J. Atterbury 1 Oct. 1967 16 p refs

(Contract W-7405-ENG-92)

(BMI-1817) CFSTI: HC $3.00/MF $0.65

In determining the size of defects required to initiate fracture in typical PWR and BWR primary coolant piping and the extent of rupture, two tests were conducted on 24 in. OD A106B carbon steel pipe with a 1.5 in thick wall. The object of the first test was to examine the extent of fracture propagation in a test specimen containing a wet vapor of ≈1.4% quality steam. The fracture propagated the length of the pipe in an unstable manner believed to be the result of the decompression characteristics of the wet vapor. The second test was to obtain information on the behavior of through-wall cracks at relatively high stress level under pressurized water conditions. The fracture extended on each end of the test specimen in a ductile mode ≈8.5 in. NSA

N68-14548# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

A STUDY OF IMPACT EFFECTS ON SPHERICAL SHELLS. PART 1: A THEORETICAL STUDY OF THE RESPONSE OF HOLLOW CYLINDERS TO IMPACT LOADS

Larry W. Oline and Charles E. Stoneking Nov. 1966 104 p refs Sponsored by AEC Prepared for Sandia Corp.

(SC-CR-66-2135) CFSTI: HC $3.00/MF $0.65

The structural integrity of cylindrical shells under high velocity axial impact is investigated. A modified strain-rate theory is proposed to describe the material above the elastic limit. A failure criterion is established and investigated for various lengths, radius-to-wall thickness ratios and impact velocities. The application of a shell theory with shear, bending, and radial inertia was also investigated. The failure velocities determined from the plastic membrane theory are below those of the corresponding experimental results. As the wall thickness to radius ratio becomes smaller, the cylindrical shell becomes closer to a true membrane for which the theory was designed. The bending theory was investigated to compare the results with the elastic membrane theory and to show the buckling deformation developing. There was no expectation that the strictly elastic theory would predict failure velocities. The bending theory essentially oscillates about the membrane theory. Author (NSA)

N68-14551* California Univ., Berkeley.

ANALYSES OF SHELLS OF REVOLUTION BY FINITE ELEMENTS

E. P. Popov 7 Sep. 1967 12 p refs Presented at Intern. Congr. on the Appl. of Shell Struct. in Architecture, Intern. Assoc. for Shell Struct., Mexico City, 3–7 Sep. 1967

(Grant NsG-274)

(NASA-CR-91687) CFSTI: $3.00 CSCL 20K

A survey of the available methods of analysis for rotational shells using the finite element procedure is presented. The discussion is limited to the static analysis of shells such as are encountered in architectural and related applications. The versatility of the finite element procedure of stress analysis for shells of revolution of free-form is demonstrated. Author

N68-14554 Lockheed Missiles and Space Co., Sunnyvale, Calif.

INTERNAL STRESSES IN MEDIA WITH MICROSTRUCTURE

I. A. Kunin 14 Jan. 1967 13 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 3, no. 5, 1967 p 889–896

A theory of internal stresses, which is an extension of the elastic continuum theory of dispersion, is considered. Taking the microstructure into account allows greater applicability of the theory and brings it closer to the theory of crystal lattice defects. The state of the medium is described by internal and external distortions, where the former is governed by the condition of orthogonality, with respect to energy, of the external distortion tensor. The structure of the operator of the elastic moduli of the internal stresses is analyzed, and it is shown that it generally differs from that of the external stresses by some operator which is localized in a domain where internal stress sources are concentrated. An explicit expression for Green's tensor of internal stresses in an isotropic medium with spatial dispersion is constructed. The asymptotic of Green's tensor is analyzed, and the contribution to the asymptotic from the nonlinear dependence of the dispersion curve on the wave vector is determined. Author

N68-14561 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

AEROELASTICITY MANUAL. VOLUME 4: EXPERIMENTAL METHODS, PART 4 [MANUEL D'AEROELASTICITE. VOLUME 4: QUATRIEME PARTIE: LES METHODES EXPERIMENTALES]

W. P. Jones (Natl. Phys. Lab., Teddington, Engl.), ed. [1967] 367 p refs In FRENCH

CFSTI: $3.00

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6. CONDITIONS OF SIMILITUDE FOR FLUTTER TESTS ON MODELS C. Scruton and N. C. Lambourne (Natl. Phy. Lab.) 34 p ref (See N68-14567 05-32)

7. CONSTRUCTION OF MODELS L. S. Wasserman (Dyn. Devices, Inc.) and W. J. Mykytow (Wright-Patterson AFB) 37 p refs (See N68-14568 05-32)

8. FLUTTER TESTS IN A WIND TUNNEL L. S. Wasserman (Dyn. Devices, Inc.) and W. J. Mykytow (Wright-Patterson AFB) 37 p refs (See N68-14569 05-32)

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10. TESTS OF FLUTTER IN FLIGHT M. O. W. Wolfe and W. T. Kirkby (Royal Aircraft Est.) 36 p refs (See N68-14571 05-32)

N68-14562* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

MEASUREMENT OF INFLUENCE COEFFICIENTS ON A STRUCTURE [MESURE DES COEFFICIENTS D'INFLUENCE SUR UNE STRUCTURE]

Dennis J. Martin and William T. Lauten, Jr. *In* ONERA Aeroelasticity Manual, Vol. 4 [1967] 39 p refs (See N68-14561 05-32)

Experimental methods used to determine the elastic properties of aircraft structures are described, along with techniques for measuring the resulting deformations. Various aspects of the method of the coefficients of influence are treated, and consideration is given to the theorem of reciprocity. The factors involved in determining the optimal combination of techniques for loading and measuring the displacements are assessed. It is pointed out that the choice of the system depends on the size of the test, the number of points where the coefficients of influence are to be measured, and on the magnitude of the anticipated displacements. A reference bibliography is included. Transl. by M.G.J.

N68-14563 Calidyne Co., Winchester, Mass.

TESTS OF GROUND VIBRATION [ESSAI DE VIBRATION AU SOL]

R. C. Lewis and D. L. Wrisley (Wrisley Eng., Inc.) *In* ONERA Aeroelasticity Manual, Vol. 4 [1967] 27 p refs (See N68-14561 05-32)

The problems involved in ground vibration tests of aircraft and missile structures are surveyed to assess the experimental techniques used to determine the frequency, deformation, and absorption coefficient properties of each of the several modes that are characteristic of a complex structure. The required test equipment is discussed in terms of the generators which supply and control the excitation sources; and the instruments which measure and/or record the frequency, the amplitudes of the response, the forces applied, and the period between the responses at different points or between the response and the force. Test techniques are discussed with attention centered on the use of multiple excitation, component analyses, and the application of admittance concepts. Transl. by M.G.J.

N68-14564 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

MEASUREMENT OF THE ABSORPTIVITY OF STRUCTURE AND OF THE GENERALIZED MASS [MESURE DE L'AMORTISSEMENT DE STRUCTURE ET DE LA MASSE GENERALISSEE]

H. Gauzy *In its* Aeroelasticity Manual, Vol. 4 [1967] 39 p refs (See N68-14561 05-32)

Consideration is given to the elementary case of a linear, viscous system with a single degree of freedom. General formulas are derived to define the absorption coefficient, and equations are presented for measuring this coefficient from frequency scanning, from the resonant frequencies due to energy dissipation, and during the transition state. A system of differential equations is given for determining the influence of dry friction on the aircraft structure. Techniques for measuring generalized masses by frequency displacement characteristics and through energy dissipation properties are mathematically described. Transl. by M.G.J.

N68-14565 De Havilland Div., Hawker Siddeley Aviation, Ltd., Edgeware (England).

EXPERIMENTAL TECHNIQUES FOR IMPEDANCE MEASUREMENTS OF SERVOCONTROLS [TECHNIQUES EXPERIMENTALES DE MESURE DE L'IMPEDANCE DES SERVO-COMMANDES]

J. C. Hall *In* ONERA Aeroelasticity Manual, Vol. 4 [1967] 24 p (See N68-14561 05-32)

As a basis of calculating aileron stability, experimental methods of measuring the impedance of servocontrol systems are considered. The influence of the servocontrol structure on the dynamic behavior of the system is discussed, and the stability of an elementary system and the impedances of an elementary and a real system are defined. Test programs are examined in terms of the amplitude of the applied dynamic loads, the size of the static load, the aileron movement regime, and breakdown conditions. Various test methods and the instrumentation required are described. Also included are the equations of motion for an elementary hydraulic jack. Transl. by M.G.J.

N68-14567 National Physical Lab., Teddington (England). Aerodynamics Div.

CONDITIONS OF SIMILITUDE FOR FLUTTER TESTS ON MODELS [CONDITIONS DE SIMILITUDE POUR LES ESSAIS DE FLOTTEMENT SUR MAQUETTE]

C. Scruton and N. C. Lambourne *In* ONERA Aeroelasticity Manual, Vol. 4 [1967] 34 p ref (See N68-14561 05-32)

The conditions of similitude directly related to kinetic heating are established, and the similitude laws are defined. Consideration is given to the physical quantities, the support of the model during the tests, the Reynolds number, the gravitational parameter, and the absorption. The fundamental requirements for applying these similitude laws are discussed in relation to high speed wind tunnel tests, model tests at low speeds, tests on models mounted on a trolley and on a rocket, aeroballistic engine firings, and tests of models in free flight. The advantages of flutter tests in gases other than air are cited, and the characteristics of flutter which are dependent on internal geometry and physical structure are listed. Transl. by M.G.J.

N68-14568 Dynamic Devices, Inc., Dayton, Ohio.

CONSTRUCTION OF MODELS [CONSTRUCTION DES MAQUETTES]

Lee S. Wasserman and Walter J. Mykytow (Wright-Patterson AFB) *In* ONERA Aeroelasticity Manual, Vol. 4 [1967] 37 p refs (See N68-14561 05-32)

The use of models for predicting flutter is traced from its inception about 1940 to illustrate the growing importance attached to these techniques. Similitude laws are reviewed briefly, and the relationships between aircraft and model are established. The factors affecting the scale and choice of the models are assessed in relation to the various test methods and the simulation problems which will be encountered. To illustrate, several examples are given of flutter models constructed to test flexural and torsional rigidity, to determine elasticity, thermoelasticity, and structural stability; and to withstand subsonic, transonic, and supersonic speeds. Mounting methods and test equipment are described. Transl. by M.G.J.

N68-14569 Dynamic Devices, Inc., Dayton, Ohio.

FLUTTER TESTS IN A WIND TUNNEL [ESSAIS DE FLOTTEMENT EN SOUFFLERIE]

Lee S. Wasserman and Walter J. Mykytow (Wright-Patterson AFB) *In* ONERA Aeroelasticity Manual, Vol. 4 [1967] 37 p refs (See N68-14561 05-32)

The results that can be obtained from flutter model tests are discussed in relation to the transient and harmonic excitation techniques which may be used. The variable parameters influencing the choice of wind tunnels for flutter tests are examined, and test

difficulties are defined in terms of model instabilities and structural separation of the models. Criteria for establishing the test programs and evaluating the results are proposed. Test data obtained by NASA are discussed to illustrate the effects of the Mach number and the Reynolds number on flutter. Transl. by M.G.J.

N68-14571 Royal Aircraft Establishment, Farnborough (England).
TESTS OF FLUTTER IN FLIGHT [ESSAIS EN VOL DE FLOTTEMENT]
M. O. W. Wolfe and W. T. Kirkby *In* ONERA Aeroelasticity Manual, Vol. 4 [1967] 36 p refs (See N68-14561 05-32)

The fundamental problems of flutter are discussed in relation to the development of high speed aircraft, and the test techniques which have evolved over the past two decades are reviewed. Two fundamental aspects are considered: forecasting the spectrum of the aerodynamic functions which comprise the entire system, and determining the dynamic response of the aircraft to these excitation functions. Two techniques used to study the vibration characteristics of an aircraft in response to sinusoidal excitation are examined: amplitude frequency, and vector analysis. Various methods of excitation are assessed, and their respective advantages are noted. Techniques for decreasing oscillations are described. Methods of measuring aircraft response are discussed, and procedures for test planning are outlined. Transl. by M.G.J.

N68-14584* Dynamic Science Corp., Monrovia, Calif.
A GEOMETRICALLY NONLINEAR ANALYSIS OF ARBITRARILY LOADED SHELLS OF REVOLUTION
R. E. Ball Washington NASA Jan. 1968 218 p refs
(Contract NAS1-5804)
(NASA-CR-909) CFSTI: $3.00 CSCL 20K

A digital computer program for the geometrically nonlinear analysis of thin elastic shells of revolution subjected to arbitrary load and temperature distributions was developed to predict snap buckling of spacecraft shell structures due to asymmetric loads such as those imposed by reentry flow or landing impact. The analysis was based upon Sanders' nonlinear shell theory for the condition of small strains and moderately small rotations. The nonlinear partial differential equations are reduced to a sequence of linearized uncoupled ordinary differential equations by expanding the variables into Fourier series in the circumferential direction, and treating the nonlinear terms as pseudo loads. The linearized equations are repeatedly solved, using a finite difference formulation in conjunction with a Gaussian elimination procedure, until the solution converges. Author

N68-14640*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PLASTIC BEHAVIOR OF CIRCULAR PLATES UNDER TRANSVERSE IMPULSE LOADINGS OF GAUSSIAN DISTRIBUTION
Robert G. Thomson Washington Jan. 1968 33 p refs
(NASA-TR-R-279) CFSTI: HC $3.00/MF $0.65 CSCL 20K

An analytical study of the plastic response of a circular plate of uniform thickness subjected to a normal axisymmetric impulse of Gaussian distribution is presented. The Gaussian impulse loading is assumed initially to impart a momentum to the plate. The plate is thereafter prescribed as free from external loads. The kinetic energy of motion is assumed to be dissipated in plastic deformation. The radial and circumferential strain and strain-rate distributions of the plastically deforming plate are determined as a function of time and space from derived deflection expressions. Only the bending action of the plate is taken into account and the plate material is assumed to behave as a perfectly plastic-rigid continuum. The possibility of a fracture or separation of the plate material occurring during deformation is discussed. Maximum values of strain and strain rate are shown to occur in the circumferential components, and a mode of failure by radial fractures is indicated. Author

N68-14648*# Wyle Labs., Huntsville, Ala.
RESPONSES OF RECTANGULAR PANELS TO RANDOM ACOUSTIC EXCITATIONS BY MECHANICAL IMPEDANCE MEASUREMENT TECHNIQUES
G. C. Kao Jun. 1967 47 p refs
(Contract NAS8-5384)
(NASA-CR-91812; WR-67-10) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Analytical development of mechanical impedance measurement techniques to predict responses of linear structures to random acoustic excitations is presented. The investigation shows that the point impedance and the transfer impedance data of complex structures could be used to compute frequency-average mode shapes and joint acceptance functions; these quantities could, then, be used to predict structural responses. Three rectangular aluminum panels were tested. Mechanical impedance measurements and acceleration response data to sinesweep and random acoustic excitations were obtained. Author

N68-14651* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RESEARCH ACHIEVEMENTS REVIEW. VOLUME 2. CRYOGENIC TECHNOLOGY RESEARCH AT MSFC
1967 91 p refs
(NASA-TM-X-53670; Rept.-7) CFSTI: $3.00 CSCL 21H

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4. CRYOGENIC INSULATION MANUFACTURING TECHNOLOGY I. C. Yates, Jr. p 43–53 refs (See N68-14655 05-15)
5. DEVELOPMENT OF A COMBINED HIGH PERFORMANCE MULTILAYER INSULATION AND MICROMETEOROID PROTECTION SYSTEM J. M. Stuckey p 55–68 (See N68-14656 05-15)
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7. ASSESSMENT OF THE STATUS OF CRYOGENIC INSULATION DEVELOPMENT C. C. Wood p 81–83 ref (See N68-14658 05-33)

N68-14654* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DESIGNING FOR CRYOGENIC INSULATION
Clyde D. Nevins *In its* Res. Achievements Rev., Vol. 2 1967 p 29–42 refs (See N68-14651 05-32)

Structural design studies show that the type and means of application of high performance insulation will be a major influence on the design of spacecraft with cryogenic propellants. MSFC and several contractors have investigated many insulation systems in thicknesses up to 2.5 cm (1.0 in.) for compatibility with the adverse environments of a rocket vehicle launch. Purged insulation systems now appear much better suited than pre-evacuated systems, both from the ease of attachment and reliability of the insulation covering. Author

N68-14657* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NUCLEAR GROUND TEST MODULE INSULATION DEVELOPMENT
Raymond L. Gause *In its* Res. Achievements Rev., Vol. 2 1967 p 69–79 refs (See N68-14651 05-32)

A description is given of Project Rover and the Nuclear Engine for Rocket Vehicle Applications (NERVA). The Nuclear

Ground Test Module (NGTM) program at MSFC is discussed and the relationship between the NGTM program and the NERVA program is established. The criteria for the design of an insulation system for the NGTM are presented. In addition, the NGTM environment and the impact of this environment on the development of an insulation system with the desired properties are discussed. The selection of the candidate materials for the NGTM insulation system is given and the test program for evaluating their suitability for full-size tanks is outlined. Author

N68-14670# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
STRESS-RUPTURE PARAMETERS: ORIGIN, CALCULATION, AND USE
J. B. Conway 30 Jun. 1967 400 p refs
(Contract AT(40-1)-2847)
(GEMP-555) CFSTI: HC $3.00/MF $0.65

A review of the origin, calculation and use of the Larson–Miller, Dorn, Manson–Haferd, Graham–Walles, Murry, Brozzo, and Chitty–Duval parameters of stress–rupture is presented. These parameters are discussed using the Clauss, Larke and Inglis, and Murry evaluations and analyzed by the principle of Least Squares. A bibliography of 77 references is included. NSA

N68-14684* North Carolina State Coll., Raleigh. Dept. of Civil Engineering.
FREE VIBRATION OF STIFFENED CYLINDRICAL SHELLS Final Report
Donald McDonald Oct. 1967 98 p refs
(Contract NAS8-20391)
(NASA-CR-91777) CFSTI: $3.00 CSCL 20K

The equations of the composite structure are derived, using only the approximations applicable to the theory of beams and shells. The equations are solved for the particular case of a freely supported shell, and the coefficients of the frequency determinant and the functional form of the modes are derived. Included are solutions for the vibration of several shells. C.T.C.

N68-14755 Catholic Univ. of America, Washington, D. C.
RESPONSE OF AN UNLIMITED SHALLOW SPHERICAL SHELL TO AN OSCILLATING AXISYMMETRIC PRESSURE
Edward B. Magrab Dec. 1967 12 p refs
(Grant NSF GK-782)
(Rept.-6)

Naghdi and Orthwein, as part of their general treatment to a class of problems involving elastic and viscoelastic infinitely extended shallow spherical shells, obtained a solution in integral form for the transverse displacements of an unlimited elastic shallow spherical shell due to a harmonically varying axisymmetric pressure acting on a small area about the shell's apex. They then stated, however, that this solution did not admit a closed representation. It is the purpose of this note to show that a closed solution is available for a range of shell and frequency parameters. From the displacement, the stress resultants and stress couples are easily obtained. The dynamic solution is shown to reduce to the static solution obtained by Reissner. Author

N68-14786# Sandia Corp., Albuquerque, N. Mex.
RESPONSE OF AN ELASTIC MEDIUM TO A MOVING SHEAR LOAD
T. R. Rogge Oct. 1967 25 p refs
(Contract AT(29-1)-789)
(SC-TM-67-779) CFSTI: HC $3.00/MF $0.65

An analysis is presented which gives the nontransient, steady-state solution for both a half space and an infinite slab when subjected to a moving shear load. The solutions show the wave propagation characteristics of these problems. Author (NSA)

N68-14789 Mitsubishi Heavy Industries, Ltd., Nagasaki (Japan).
ON THE COUPLED TORSIONAL–HORIZONTAL VIBRATION OF SHIPS
Katsuo Ohtake, Toyoji Kumai, Masao Ushijima, and Masatomo Ohji Nov. 1967 15 p refs
(MTB-010054)

A numerical computation method for the coupled torsional–horizontal vibration of ships was developed and coded for the IBM-7040 computer. The characteristics of coupled vibration were studied for uniform beams by the analytical and the numerical methods. The frequency calculation was made on four ships, and the results were compared with the measured frequencies. Agreement between calculated and measured frequencies differed by about 10%. Author

N68-14854* Midwest Applied Science Corp., Lafayette, Ind.
THE DEVELOPMENT OF COMPUTATIONAL TECHNIQUES FOR THE IDENTIFICATION OF LINEAR AND NONLINEAR MECHANICAL SYSTEMS SUBJECT TO RANDOM EXCITATION, PART 1 Final Report
Will Gersch Feb. 1967 75 p refs
(Contract NAS5-10106)
(NASA-CR-91803) CFSTI: $3.00 CSCL 20K

Computational procedures are suggested for determining the differential equation governing the motion of linear and nonlinear structural systems subject to random excitation when the system response is observed. Transfer functions, impedances, and damping coefficients of linear systems are obtained, along with coefficients governing the motion of the structure. The approach was to (1) determine a mathematical model to describe the discrete time series that corresponds to the regularly sampled continuous system output data, (2) investigate procedures to estimate the parameters of this discrete time model, and (3) transform these discrete time parameter estimates to the continuous system parameters of interest. C.T.C.

N68-14901# Tennessee Univ., Knoxville. Dept. of Mechanical and Aerospace Engineering.
EXPERIMENTAL ANALYSIS OF THE ATTACHMENT REGION OF HEMISPHERICAL SHELLS WITH ATTACHED NOZZLES. PART 2: RADIAL NOZZLE, 7.875 O.D.-7.125 I.D., 10.00 IN. PENETRATION
R. L. Maxwell and R. W. Holland Apr. 1967 280 p
(Contract W-7405-ENG-26)
(TID-24103) CFSTI: HC $3.00/MF $0.65

Results of investigations to determine the stress patterns for the junction region of spherical shells with radially attached nozzles when subjected to internal pressure and various types of loadings on the nozzles are described. The tests were conducted on a hemisphere with a large radial nozzle of 7.875 in. OD and 7.125 in. ID and a 10 in. penetration into the hemisphere. Stress patterns were determined for the following five types of loadings: internal pressure applied to the hemisphere and nozzle assembly; an axial load applied collinear with nozzle; a pure bending moment, or couple, applied to the nozzle; a transverse or shear load applied normal to the nozzle; and a pure torque applied to the nozzle. The results of the experimental analysis are tabulated and normalized stresses versus vessel profile plotted for the various types of loads. NSA

N68-14932# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
IMPACT OF TWO ELASTIC CYLINDERS: SHORT TIME SOLUTION
W. R. Spillers and A. Callegari Nov. 1967 20 p refs
(Contract Nonr-266(78))
(TR-41; AD-662239)

The short time response for the longitudinal impact of two elastic cylinders is determined from the behavior of the solution

in transform space (Fourier, Laplace) for large values of the transform parameters. It is shown that this response is similar to that of an acoustic half-space in which the velocity of sound corresponds to the velocity of P waves in the elastic medium.
Author (TAB)

N68-14938 Commissariat a l'Energie Atomique, Paris (France).
MEASURE OF THE SPEED OF SOUND ON THE HUGONIOT OF ALUMINUM BY THE STATIONARY OBLIQUE SHOCK METHOD [MESURE DE LA CELERITE DU SON SUR L'HUGONOIT DE L'ALUMINIUM PAR LA METHODE DES CHOCS OBLIQUES STATIONNAIRES]
F. David, G. Verdes, F. Proutesu, and M. Battistelli 15 Sep. 1967 6 p refs In FRENCH Presented at High Dyn. Pressure, Paris, 11–15 Sep. 1967

A method is described to measure the speed of sound behind a stationary oblique shock induced in a metal block from the impact of a plate of the same metal. Two synchronized cameras were used to provide the necessary precision during measurement. It is shown that a knowledge of the Hugoniot and the speed of sound enable determination of the Mie-Gruneisen equation of state in the domain where the electronic state cannot be neglected. Results are included for an alloy that contains 93% aluminum.
Transl. by M.W.R.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-13912 Technische Hochschule Munchen (West Germany).
CALCULATING THERMODYNAMIC VALUES OF HOT AIR IN EQUILIBRIUM ZONE BEHIND A COMPRESSION SHOCK [DIE BERECHNUNG DER THERMODYNAMISCHEN GROESSEN VON HOCHERHITZTER LUFT IM GLEICHGEWICHTSBEREICH HINTER EINEM VERDICHTUNGSSTOSS]
E. Igenbergs and L. Roemer *In* WGLR Meeting Rept. of the WGLR Tech. Comm. on Aerodyn.–Hypersound Aerodyn. Jul. 1967 p 88–90 In GERMAN (See N68-13908 05-01)

The hot air behind a hypersonic atmospheric reentry body is regarded as real gas whose thermodynamic values can be determined from the temperatures and densities of its main components: O_2, N_2, O, N, NO, NO^+, O^+, N^+, and e^-. Computer iteration obtained pressures, densities, temperatures, compressibility, and enthalpy, as well as the concentration of air components in the thermodynamic equilibrium behind shocks as functions of the Mach number and gas flow properties before shock.
Transl. by G.G.

N68-13913 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany).
STUDY OF HEAT TRANSFER ON A PROTRUDING CENTRAL SPIKE OF BLUNT BODIES [UNTERSUCHUNGEN UEBER DEN WAERMEUEBERGANG AM ZENTRALSTIFT VON STUMPFEN KOERPERN]
H. Kabelitz, W. Wyborny, and H. Schepers *In* WGLR Meeting Rept. of the WGLR Tech. Comm. on Aerodyn.–Hypersound Aerodyn. Jul. 1967 p 92–124 refs In GERMAN (See N68-13908 05-01)

The effects of a protruding center spike on the hypersonic flow around a rotating symmetrical blunt body were investigated. Heat transfer as well as energy measurements and theoretical analyses established a definite decrease in flow resistance values depending on the angle of attack. A simple arithmetic correlation was found between the separation angle and the flow length of the laminar boundary layer up to the separation point. Heat transfer measurements on the spike indicated a pronounced recirculating wake flow and the formation of a spike boundary layer.
Transl. by G.G.

N68-13966# Bolkow Entwicklungen K. G., Munich (West Germany).
MEASUREMENT OF HEAT FLOW IN THE INSULATION OF CRYOGENIC FUEL TANKS [DIE MESSUNG DES WAERMEFLUSSES AN DER ISOLIERUNG VON TANKS FUER KRYOGENE TREIBSTOFFE]
Egon Mueller, Frauke Hennings, Edgar Klippel, and Josef Misterek 13 Sep. 1966 38 p refs In GERMAN Presented at the Ann. Joint Meeting DGRR/WGLR, Bad Godesberg, W. Germany, Oct. 1966
(DGRR/WGLR Paper-66-043; EV-59-0) CFSTI: HC $3.00/MF $0.65

Starting with the background theory, this paper describes fuel tank insulation techniques developed to meet the requirements of lengthy missions by space probes and satellites using cryogenic upper stages. This is followed be details of test equipment constructed, and the results obtained (using liquid-nitrogen-filled tanks) in measuring the relative effectiveness of superinsulation (up to 45 thicknesses) compressed superinsulation with spacers, and foam insulation.
ESRO

N68-13967# Idaho Nuclear Corp., Idaho Falls.
ZIRCALOY-4, URANIUM DIOXIDE, AND MATERIALS FORMED BY THEIR INTERACTION. A LITERATURE REVIEW WITH EXTRAPOLATION OF PHYSICAL PROPERTIES TO HIGH TEMPERATURES
R. R. Hammer Sep. 1967 38 p refs
(Contract AT(10-1)-1230)
(IN-1093) CFSTI: HC $3.00/MF $0.65

The physical properties of UO_2, ZrO_2, UO_2–ZrO_2 solid solutions, ZrO_{2-x}, and Zircaloy-4 were reviewed. Recommended and extrapolated values of these physical properties are given. The properties covered are: transition temperatures, heat capacities, heat contents, vapor pressures, thermal conductivities and thermal expansion. The temperature ranges and materials covered were geared for use in the analysis of a loss-of-coolant reactor accident.
Author (NSA)

N68-14042*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF TURBULENT LIQUID-METAL HEAT TRANSFER IN CHANNELS WITH HEAT SOURCES IN THE FLUID POWER-LAW VELOCITY PROFILE
Robert M. Inman Washington Jan. 1968 39 p refs
(NASA-TN-D-4336) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An analysis is made to determine the heat-transfer characteristics for turbulent flow of a heat-generating liquid metal between parallel plates with wall heat transfer. The internal heat generation is uniform over the channel cross section and along its length. The wall heat transfer is also uniform along the channel length. The analysis applies in the thermal entrance region of the channel as well as far downstream. The fluid is assumed to have a fully developed, turbulent power-law velocity profile which is unchanging throughout the length of the channel. The idealized eddy diffusivity profile proposed by Poppendiek is used. Numerical results for the wall temperature distribution and Nusselt number variation are presented in graphical form for a 1/7-power-law velocity profile and for values of k ranging from 1 to 5. Results for the fully developed Nusselt numbers for liquid metal flow without internal heat generation are compared with existing calculations (based on the assumption that the eddy diffusivities of heat and momentum are equal) and exhibit good agreement.
Author

N68-14052* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

NONLINEAR HEAT TRANSFER AND TEMPERATURE DISTRIBUTION THROUGH FINS AND ELECTRIC FILAMENTS OF ARBITRARY GEOMETRY WITH TEMPERATURE-DEPENDENT PROPERTIES AND HEAT GENERATION

A. R. Shouman Washington Jan. 1968 44 p refs
(NASA-TN-D-4257) CFSTI: $3.00 CSCL 20M

A theoretical analysis was conducted of one-dimenrional, steady-state, heat exchange by both convection and radiation between a rod or a fin and their surroundings. The analysis consiclers both the cases where the heat is being dissipated or received by the fin or rod. Both the infinite and finite length cases are considered. The surroundings equivalent temperature for radiation could be different from that for convection. The fin or rod could have an arbitrary geometry and its physical properties could be temperature dependent as well as displacement dependent. The analysis also considers the effect of heat generation or absorption. The exact solution of the problem for a constant area fin or rod with constant thermal properties is presented. The solution produces two functions of parametric nature. The different parameters are dependent on the boundary conditions. A computer program for evaluating the functions was written. It was shown that the heat generation or absorption cases are reducible to the simple case through a suitable transformation. After this transformation, the tabulated functions can be used for solving problems with internal heat generation or absorption. Author

N68-14062# Bolkow Entwicklungen K. G., Munich (West Germany).

THERMAL STRATIFICATION IN FUEL TANKS UNDER GAS PRESSURE [THERMISCHE SCHICHTUNG IN TREIBSTOFF-TANKS]

Eric Huber 16 Sep. 1966 44 p refs In GERMAN Presented at the Ann. Joint Meeting DGRR/WGLR, Bad Godesberg, W. Germany, Oct. 1966
(DGRR/WGLR Paper-66-075; FM-348-O) CFSTI: HC $3.00/MF $0.65

Describes the heat and mass exchange processes in a rotationally symmetrical and partially liquid-filled, externally heated and longitudinally accelerated tank, from the lower end of which fluid is drawn off and at the upper end of which warm condensable gas is fed in under pressure. The accompanying relationships are in a form that is suitable for numerical integration by digital computers and provides the basis for a Fortran program. Author (ESRO)

N68-14096# Atomics International, Canoga Park, Calif.

THERMOPHYSICAL PROPERTIES OF SNAP FUEL MATERIALS

M. M. Nakata, C. J. Ambrose, and R. A. Finch 25 Sep. 1967 93 p refs
(Contract AT(04-3)-701)
(NAA-SR-11959) CFSTI: HC $3.00/MF $0.65

Results of thermal diffusivity, heat capacity, thermal conductivity, and electrical resistivity measurements, made on SNAP fuel materials, are presented. Compositions investigated include the unhydrided zirconium–10 wt% uranium alloy and the alloy hydrided to 0.50, 1.26, 1.58, 1.81, and 1.90 H/Zr atom ratios. Anomalies observed in the property vs temperature curves are discussed and related to the available phase diagrams. Author (NSA)

N68-14171*# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.

SOLAR RADIATION INDUCED DAMAGE TO OPTICAL PROPERTIES OF ZNO-TYPE PIGMENTS Technical Summary Report, Jun. 27, 1966–Mar. 27, 1967

M. E. Browne, K. F. Cuff, S. A. Greenberg, H. F. MacMillan, A. F. Sklensky et al Jun. 1967 90 p refs
(Contract NAS8-18114)
(NASA-CR-61429) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Results are reported on investigation of the mechaniam of solar radiation damage to the optical properties of ZnO pigment. Solar U-V irradiation of particulate ZnO in vacuum produces significant decreases in reflectance in the visible region adjacent to the fundamental band-edge and in the I-R region between 0.8 and 2.8 μ. Emphasis has been placed on identification of the processes of I-R degradation using experimental evidence from ESR, electrical conductivity, and spectral reflectance measurements performed during U-V irradiation in vacuum and recovery from degradation in oxygen. The results have led to formulation of a degradation model which qualitatively accounts for all of the observed data. With reasonable confidence the UV-induced I-R absorption is attributed to excitation from bound donor states associated with oxygen vacancies resulting from lattice photolysis. The induced visible absorption is tentatively assigned to states or to lattice strain resulting from diffusion of surface zinc to sites in the particle bulk. Author

N68-14177* Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

OPTIMUM SYSTEMS FOR DISSIPATING HEAT BY RADIATION [OPTIMAL'NIYE SYSTEMY OTUODA TEPLA IZLUCHENIYEM]

G. L. Grodzovskiy and Yu. G. Zhulev Washington NASA Dec. 1967 10 p refs Transl. into ENGLISH from Russian Presented at the 18th Congr. of the Intern. Astron. Federation, Belgrade, 25–30 Sep. 1967
(Contract NASw-1692)
(NASA-TT-F-11433) CFSTI: $3.00 CSCL 20M

This discussion of radiator systems for dissipating heat energy includes consideration of optimum heat-dissipating elements with minimum mass, energy-dissipating systems using a flat tubed radiator with fins, and a tubed radiator with a stellate arrangement of fins. Annular heat-dissipating fins and systems for using a belt to carry heat away are also described, along with generalized characteristics of heat-dissipating radiator systems. Author

N68-14219# Bureau of Mines, Albany, Oreg. Albany Metallurgy Research Center.

STUDY OF HEAT TRANSFER TO WATER-COOLED COPPER CRUCIBLES DURING VACUUM ARC MELTING

P. G. Clites and R. A. Beall [1967] 36 p refs Sponsored by AEC
(BM-RI-7035) CFSTI: HC $3.00/MF $0.65

Values of heat flux from the ingot to the crucible were determined during nonconsumable electrode vacuum arc melting of zirconium and during consumable electrode vacuum arc melting of titanium, zirconium, and steel. The results of these studies confirm the existence of a high thermal resistance between the ingot and the crucible wall which results from the shrinkage of the ingot as the metal solidifies. Maximum heat flux occurs near the top of the ingot where maximum values of heat flux of 1.4×10^6 Btu/ft^2 hr were observed during small-scale consumable electrode arc melting of zirconium and titanium. The maximum heat flux for consumable electrode arc melting of 8-inch-diameter ingots was 0.5×10^6 Btu/ft^2 hr. The effects of electrode material, electrode diameter, arc current, and arc potential on heat flux from the ingot to the crucible were studied. Author (NSA)

N68-14240*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CORRELATION OF LOCAL HEAT TRANSFER COEFFICIENTS FOR SINGLE PHASE TURBULENT FLOW OF HYDROGEN IN TUBES WITH TEMPERATURE RATIOS TO 23

Maynard F. Taylor Washington Jan. 1968 22 p refs
(NASA-TN-D-4332) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The existing methods of correlating and predicting single-phase turbulent heat-transfer coefficients with variable properties give coefficients which are sometimes in poor agreement with measured values. Each prediction method can be used only over a limited range of pressure, temperature, ratio of axial position to diameter, and ratio of surface to fluid bulk temperature ratio. Local heat-transfer coefficients for hydrogen from 10 investigations using symmetrically heated straight tubes were used to determine a single equation that will predict heat-transfer coefficients over a wide range of conditions including surface to fluid bulk temperature ratios to 23. Author

N68-14252# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
EXPERIMENTS WITH 7 ROD ELEMENT HEAT TRANSFER IN AXIAL FLUX OF SODIUM COOLANT [PREDLOZHENIE EKPERIMENTA TEPLOOTDACHI U 7-STERZHNEVOGO ELEMENTA V OSEVOM POTOKE NATRIEVOGO TEPLONOSITELYA]
M. Pashek May 1967 20 p refs In RUSSIAN; ENGLISH summary
(UJV-1814)

Seven-rod experimental elements for the investigation of the temperature fields and local heat transfer coefficients were constructed. The problem of reliable electrical heating of the rods of 14-mm diameter attaining a heat current of 31,900 kcal/m^2 hr was solved and the surface temperature of the rods was measured by means of microthermocouples. A mobile thermozone for the measurement of the temperature fields in the Na was proposed and described. The proposed method was verified on water. Author (NSA)

N68-14270*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THEORETICAL TEMPERATURES OF THIN-FILM SOLAR CELLS IN EARTH ORBIT
Curt H. Liebert and Robert R. Hibbard Washington Jan. 1968 17 p refs
(NASA-TN-D-4331) CFSTI: HC $3.00/MF $0.65 CSCL 10A

An analysis was made and equations and charts were developed that make it easy to calculate the temperatures of opaque, thin, flat plates in a Sun-planet system. The analysis is general and includes the effects of sunlight, albedo, and Earth radiation at any altitude and for any orientation; it requires that the absorptance and emittance of the plate surfaces be known. This analysis was applied to three thin-film cadmium sulfide solar cells, and it uses experimentally determined optical properties to calculate equilibrium temperatures in various Earth orbits. The calculations consider the effect of painting the inactive side with a black paint or a white, zinc oxide (ZnO) paint and the effect of lowering the solar absorptance of the active side at wavelengths not used in photovoltaic energy conversion. The results show that the temperature of present day cells with the inactive side not painted may vary from 346° K in sunlight to 92°K in the Earth's shadow. It was observed that the temperatures in sunlight may be lowered by painting the inactive side with a ZnO paint. Further temperature reductions may be achieved by lowering the solar absorptance of the active side at wavelengths not used in photovoltaic energy conversion. Author

N68-14298 Gt. Brit. National Inst. for Research in Nuclear Science, Chilton.
OPTICAL DISTORTIONS IN BUBBLE CHAMBERS ARISING FROM TURBULENT CONVECTIVE MOTIONS
D. B. Thomas *In* CERN Intern. Colloq. on Bubble Chambers, Vol. 1 Aug. 1967 14 p refs (See N68-14281 05-24)

Thermal turbulence in bubble chambers is caused by local heat deposition during bubble growth and recompression cycling and by the heat transfer from a rigid boundary in the fluid to or from the fluid. The greatest temperature fluctuations occur in the mixing region between the heat exchanger surface and a thin conduction layer of the fluid. Thus a considerable averaging process is needed for track curvature measurements since quite small heat fluxes produce measurable positional errors in chambers with depths of several meters. Example calculations for a chamber of 3.5 meter diameter found average errors on the position of single bubbles of about 600 microns for tracks viewed through 3 meters of liquid hydrogen when the total heat transport through the chamber was 100 watts. G.G.

N68-14370# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
UNSTABLE COMBUSTION OF ADVANCED SOLID PROPELLANTS Final Report, 27 Jun. 1966–26 Jun. 1967
Christoper L. Morfey and Samuel Temkin Sep. 1967 146 p refs
(Contract DA-18-001-AMC-1134(X))
(BBN-1547; AD-662759)

The report consists of several investigations of important problems regarding acoustic combustion instability in solid propellant rocket motors. The aims of these investigations were to understand limiting amplitudes of oscillation in motor cavities; to establish the relevance of various damping mechanisms in the nonlinear regime, and to find the conditions for coupling between orthogonal modes of oscillation that had been observed in solid-propellant motor research. The damping mechanisms considered in the nonlinear regime were the following: vent losses, particulate damping, wall losses, harmonic generation, and shock formation. The main conclusions are: (1) The limiting amplitudes of oscillation in resonant cavities can be explained in terms of gas nonlinearities. (2) In the nonlinear regime, shock dissipation may be the leading limiting mechanism for longitudinal oscillations. (3) Nonlinear wall losses may be equally important in small diameter cavities. (4) A new type of instability was found theoretically. This instability is due to coupling between longitudinal and transverse oscillations, and results in large amplitude instability. The theory for this nonlinear coupling yields conditions for its occurrence, and the conditions are in complete agreement with results obtained in solid-propellant motor research. Author (TAB)

N68-14375# Brookhaven National Lab., Upton, N. Y.
HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW, VOLUME 5, NUMBER 4 Bimonthly Technical Progress Review
Aug. 1967 188 p refs Sponsored by AEC
(BNL-50077(PR-28), V. 5) CFSTI: HC $3.00/MF $0.65

Research and development programs in the field of high-temperature liquid-metal technology are reviewed. Materials development, corrosion and mass transfer, heat transfer, fluid dynamics, instrumentation, purification, component development, physical properties, thermodynamics, chemical analysis, and power systems are covered. NSA

N68-14411# Oak Ridge National Lab., Tenn.
PROCEEDINGS OF SECOND SOUTHEASTERN SEMINAR ON THERMAL SCIENCES
H. W. Hoffman, ed., and R. I. Vachon (Auburn Univ.), ed. Oct. 1967 195 p refs Seminar held in Oak Ridge, Tenn., 25–26 Jul. 1966
(Contract W-7405-ENG-26)
(ORNL-TM-1975; CONF-660723) CFSTI: HC $3.00/MF $0.65

Lectures are included on prediction of natural convection and radiation, fictive film concept, research on boiling and condensing, and atmospheric turbulence and diffusion. Progress

reports are included on radiation gas dynamics; free convection heat transfer to air between narrow channels; stabilization of rotating flows with intense magnetic fields; turbulent transport in wall jet flow; pressure losses in tubing and fittings; arc heated wind tunnel investigation of the effect of heat-transfer rate, low density, and orifice size on static pressures; reflectance in film-covered water surfaces; solution of nonlinear equations; pool boiling on stainless steel; film and transpiration coding of hypersonic nozzle throats; similarity techniques in space vehicle testing; and transient thermal stresses in a cylinder with an internal heat source. NSA

N68-14425# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.

STUDIES OF LOCAL HEAT EXCHANGE AND HEAT FIELDS IN 7-ROD BUNDLE IN AXIAL SODIUM FLUX. DENSITY OF THE S/D-1.2 LATTICE [ISSLEDOVANIE LOKAL'NOI TEPLOOT-DACHI I TEPLOVYKH POLEI U 7-STERZHNEVOGO PUCHKA V OSEVOM POTOKE NATRIYA. PLOTNOST'RESHETKI S/D-1,2]

M. Pashek May 1967 27 p refs In RUSSIAN; ENGLISH summary
(UJV-1815)

Experimental heat transfer results were obtained for the case of a long streamlined 7-rod bundle with a lattice in the shape of a right triangle and having a density of S/d of 1.2 at lower Pe numbers. All 7 rods were electrically heated in order to obtain a constant thermal flow of 31.9 kcal/m^2-hr. The investigations were carried out in the experimental area located in the sodium loop with an effective rod length of 1 to 850mm. and 1/d of 133. The measurements were carried out for the following conditions: mean rate of Na flow =0.22 to 1.8 m/sec., $Re=2.6\times10^3$ to 14.7×10^3, Pe=21 to 120, and $Pr=7.7\times10^{-3}$ to 7.9×10^{-3}. At constant temperature, the central thermal field has an 1/d of 97 and at the thermal-field entrance the field has an 1/d of 15.7 at various Pe numbers. The discovered temperature variation effect around the rod bundle increases with decreasing Pe, and it was shown that this variation, taking place in the transition flow regime ($20<Pe<80$), is significant in the start-up of fast neutron reactors. At low sodium flow rates, e.g., Pe=10, $q\approx10^5$, the temperature differential around the fuel element is 30°C. The variation of local heat transfer coefficient and the Nu number for different regimes of fluid flow were investigated. Author (NSA)

N68-14434# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

BLOOST-6: A KINETICS CODE CONTAINING A THERMODYNAMIC MODEL OF COATED PARTICLES FOR HTGR APPLICATIONS

R. C. Dahlberg and M. H. Merrill 19 Jul. 1967 24 p refs
(Contract AT(04-3)-167)
(GAMD-8119) CFSTI: HC$3.00/MF$0.65

A computer code consisting of a space-independent kinetics code, a two-dimensional time-dependent heat transfer code, and a spherical geometry time-dependent heat transfer code for fuel particles is presented. This composite program is called BLOOST 6. The code is controlled by the kinetics program which does a fourth-order Runge–Kutta integration. This integration is effected by a variable time step which is a function of change in power level. The heat transfer section of the code computes temperature distribution in RZ geometry for an average high temperature gas cooled reactor fuel element. Transient heat transfer calculations within the fuel particle include thermal conductivities of particle kernels and coatings. The bed conductivity is taken as that of the mixtures of particles and binder. Computer input for heat transfer rates, fuel region heat capacities, temperature coefficients, delayed neutron data, normalized axial power distribution, and reactivity insertion rate is tabulated. NSA

N68-14498* National Aeronautics and Space Administration, Washington, D. C.

HEAT TRANSFER FROM THE GAS TO THE BLADE SURFACE UNDER REALISTIC CONDITIONS OF GAS-TURBINE OPERATION [TEPLOOTDACHA OT GAZA K POVERKHNOSTI LOPATOK V REAL'NYKH USLOVIYAKH RABOTY GAZOVYKH TURBIN]

Ye. R. Plotkin and Ye. I. Molchanov Jan. 1968 8 p refs Transl. into ENGLISH from the Publ. "Teplo- i Massoperenos" Minsk, Nauka i Tekhn. Press, 1966 p 284–290
(NASA-TT-F-11448) CFSTI: $3.00 CSCL 20M

The study of heat transfer to the blade surface was based on experimental data concerning the unsteady field of the blades under various operating conditions. The experimental results were used for determining the value of the heat transfer coefficients by solving the problem of unsteady heat conduction. A hydraulic integrator was used to simulate the heat conduction within the blades. The results indicate that in the actual operation of a gas turbine the boundary layer is turbulent over almost all of the surface of a blade. Author

N68-14544# Los Alamos Scientific Lab., N. Mex.

THERMAL CONDUCTIVITY OF URANIUM–PLUTONIUM CARBIDE FUELS

J. A. Leary and K. W. R. Johnson [1967] 16 p refs Presented at the Nucl. Met. Conf., Phoenix, Ariz., 4–6 Oct. 1967
(Contract W-7405-ENG-36)
(LA-DC-9059; CONF-671005-4) CFSTI: HC$3.00/MF$0.65

The thermal conductivity of uranium–plutonium carbides was reviewed. It was found that the thermal conductivity data for UC generally fall within ±20% at 200 to 2000°C. Over this range the conductivity is approximately constant at 0.05 cal/sec. cm°C. Replacement of uranium by plutonium in UC causes a significant decrease in thermal conductivity and diffusivity at 250 to 1000°C. Maximum thermal conductivity is observed in the near-stoichiometric composition range for UC and $U_{0.85}Pu_{0.15}C$. Nickel sintering aids lower the thermal conductivity and diffusivity of UC and (U,Pu)C. Apparently oxygen and nitrogen lowers the thermal conductivity of carbides. As fission products are generated in carbides fuels, it is unlikely that they will improve thermal conductivity. It seems more probable that the thermal conductivity will be reduced. There does not appear to be a satisfactory method for adjusting for the effects of porosity on thermal conductivity of carbides. More experimental work must be done on the thermal conductivity of fully characterized carbides in order to fully exploit this property in reactor applications. Future work on thermal conductivity should be related to measurement of the electrical resistivity on the same materials. Author (NSA)

N68-14580 Istituto di Ricerche Breda S.P.A., Milan (Italy).

A NEW CORRELATION FOR ROUND DUCT AND UNIFORM HEATING—COMPARISON WITH WORLD DATA

L. Biasi, G. C. Clerici, S. Garriba, R. Sala, and A. Tozzi Brussels EURATOM Sep. 1967 57 p refs
(Contract EURATOM-106-66-12-TEEI)
(EUR-3376.E; EURAEC-1874)

A new correlation, having a large range of validity and applicable to circular ducts with uniform heat flux distribution, shall be presented. This correlation is compared with most burnout data with negative inlet quality ($X_{in} < 0$) existing in the world. The mean quadratic error σ, over 4551 experimental data coming from various laboratories, is 7.26% and the 85.5% of these data has an error less than 10%. At last 576 data, which are external to the validity range, are examined and some corrective factors are suggested in order to extend the validity range of the correlation. Author

N68-14605# Atomic Energy Establishment, Winfrith (England).

APPLICATION OF A FILM FLOW MODEL TO PREDICTING BURN-OUT UNDER TRANSIENT CONDITIONS

D. C. Leslie and G. J. Kirby Aug. 1967 28 p refs
(AEEW-R-542) CFSTI: HC$3.00/MF$0.65

The film flow model developed previously has been generalized to transient situations by assuming that only convection is changed by the transient; evaporation, deposition and entrainment are assumed to be unaffected. A computer code TRABUT computes the time behavior of the mass velocity and the quality by the method of characteristics, and then integrates the film flow equations along the same characteristics until the point of burn-out or zero film flow is reached. The time delay between the onset of a transient and burnout has been computed both for flux and flow transients. These computations have been compared with those made using the standard local conditions hypothesis. The film flow model gives shorter delays in almost all cases, but the difference would not be detectable with present experimental techniques. Author (NSA)

N68-14621# Bureau of Mines, Amarillo, Tex.
EQUATIONS FOR CALCULATING VARIOUS THERMODYNAMIC FUNCTIONS OF A TWO-COMPONENT SYSTEM FROM AN EMPIRICAL EQUATION OF STATE, INCLUDING LIQUID VAPOR EQUILIBRIA DATA
Beverly J. Dalton and Robert E. Barieau Feb. 1968 77 p refs
(BM-RI-7076)

The general expressions for evaluating various thermodynamic properties applicable to a two-component system, including liquid-vapor equilibria are given. In addition, expressions are developed for some of the quantities useful in making thermodynamic consistency checks on phase equilibria data. These formulas were developed from the general principles of thermodynamics and are expressed in terms of the compressibility factor, which is assumed to be an explicit function of the molal density, the absolute thermodynamic temperature, and the composition. Author

N68-14629* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
NONSTEADY EVAPORATION OF LIQUID PROPELLANT DROPS: THE GROSSMAN MODEL
J. G. Sotter 15 Jan. 1968 26 p refs
(Contract NAS7-100)
(NASA-CR-91817; JPL-TR-32-1061) CFSTI: $3.00 CSCL 20M

Grossman's analysis of heat transfer to a liquid propellant droplet during resonant combustion is explained in a step-by-step derivation. For mathematical simplicity, Grossman assumes spherical symmetry; and radial convection within the drop is assumed to be negligible, at least near the surface. Furthermore, the evaporation history is arbitrarily divided into two parts: (1) an initial heatup period in which vaporization rate is set equal to zero, and heat is found to be conducted to a thin layer at the surface, and (2) the period of evaporation, in which the balance must be found between heat conducted to the drop and heat carried away by the vapors. In analyzing the latter period, Grossman assumes a constant surface temperature and requires that Fourier's Law of Heat Conduction need only be approximately satisfied. In this way, he avoids determining the local rates of temperature rise within the drop, and obtains the time rate of change of vaporization rate as a nondimensional expression which can be easily integrated numerically. The results seem to show that there is not much time for conduction in the drop, so that most of the incoming heat goes into evaporation. Author

N68-14646* National Aeronautics and Space Administration, Washington, D. C.
HEAT AND MASS TRANSFER NEAR THE STAGNATION POINT WHEN GAS IS INJECTED OR SUCKED THROUGH A BODY SURFACE [TEPLO- I MASSOOBMEN V OKRESTNOSTI KRITICHESKOY TOCHKI PRI VDUVE I OTSOSE PAZLICHNYKH GAZOV CHEREZ POVERKHNOST TELA]
N. A. Anfimov Jan. 1968 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mekhan. Zhidkosti i Gaza (Moscow), no. 1, 1966 p 22–31
(NASA-TT-F-11389) CFSTI: $3.00 CSCL 20M

Numerical solutions are produced and generalized for the laminar boundary layer equations in the area of the critical point of an axisymmetrical blunt body as individual gases are injected in a homogeneous external flow. Over thirty different pairs of gases are analyzed. Heat and mass exchange in a multicomponent laminar boundary layer are analyzed as mixtures of gases are injected, as well as during simultaneous injection and evacuation of various gases through the surface of the body. An approximate method is suggested for calculating heat and mass exchange in the laminar boundary layer. Author

N68-14652* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ADVANCED REQUIREMENTS FOR CRYOGENIC INSULATION
Douglas A. Gilstad *In its* Res. Achievements Rev., Vol. 2 1967 p 1–2 (See N68-14651 05-32)

Requirements examined in a research program for advancing the state of technology for prolonged storage of liquid hydrogen in space flights, are outlined. L.S.

N68-14653*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PRACTICAL INFLUENCES ON THERMAL DESIGN OF HIGH PERFORMANCE INSULATION
E. Haschal Hyde *In its* Res. Achievements Rev., Vol. 2 1967 p 3–27 refs (See N68-14651 05-32)

The thermal aspects of the helium-purged 6.35 μ aluminized mylar insulation system applied to a 2.67-m diameter tank, and future requirements and approaches are discussed. Flight configuration tank and insulation system design; purging requirements; full-scale test tank purge results; and calculated and experimental insulation performance are described. Graphic data on the thermal conductivity of insulation materials as a function of helium gas pressure is presented. Tabulated data on the effects of leaks and outgassing on the pressure at the closed end of the insulation batten; data on valves for cryogenic application; and heat penetration data on insulation with different insulation conditivities, are presented. L.S.

N68-14658* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ASSESSMENT OF THE STATUS OF CRYOGENIC INSULATION DEVELOPMENT
Charles C. Wood *In its* Res. Achievements Rev., Vol. 2 1967 p 81–83 ref (See N68-14561 05-32)

Expended efforts for high performance insulation development for space application during 1960 and 1967; and project requirement efforts for the time frame 1967 through 1970, are graphically depicted, and discussed. Solar shield and propellant state influences on the propellant storage penalty for a nuclear manned Mars braking stage are also discussed. L.S.

N68-14667 Mitsubishi Heavy Industries, Ltd., Tokyo (Japan).
DYNAMIC CHARACTERISTICS OF A BINARY RECTIFYING COLUMN
Hiroshige Shichiji (Hiroshima Tech. Inst.), Sachio Kohara (Hiroshima Tech. Inst.), and Yasutoshi Shiegenobu (Hiroshima Tech. Inst.) 1966 10 p refs In JAPANESE; ENGLISH summary
(MTB-010040)

Dynamic equations of a binary rectifying column are solved analytically assuming a constant stripping factor. Time constants in the transfer functions depend on the number of plates, stripping factor, tray hold up, etc. and are easy to calculate. Also we

discussed the heat balance equation, the solution of which explains flow rate variation due to the change of composition on trays.
Author

N68-14715# National Engineering Lab., Glasgow (Scotland).
DETERMINATION OF THE TUBE-WALL TEMPERATURE IN A HEAT EXCHANGER FROM THE TUBE RESISTANCE
G. G. Watson and R. D. Clark Jan. 1967 39 p refs
(NEL-272; NP-17095)

The use of a tube as its own resistance thermometer has been investigated in a simple steam condenser with a single tube of aluminum-brass or titanium. A precision ac bridge incorporating an inductive voltage divider was developed for measuring the very low resistance of the tube. The stability of the tube resistance was also studied. The sensitivity for a 16.5 cm (6-1/2 in.) section of the tube length was 0.05°C and the accuracy ±1/4°C after calibration. Annealing of the tube is necessary, and corrosion or erosion can cause a gradual change in calibration. The average temperature of the tube section was measured. The surface temperature may be derived assuming that the heat flux is known. Derived surface temperatures for some heat transfer measurements are compared with values predicted from the condenser performance. Resistance measurements were also made with a potentiometer in a dc circuit. Calibration and applications are discussed.
Author (NSA)

N68-14750 European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
LIQUID METALS FOR HEAT PIPES, PROPERTIES, PLOTS AND DATA SHEETS
H. E. J. Schins Nov. 1967 140 p refs
(EUR-3653.E)

For the calculation of the heat transfer in a heat-pipe many liquid and vapor data of the working fluid (metal) are required. These data are required in the region of the boiling point. Measurements were made for the twelve most current metals of the vapor pressure and the surface tension. Density measurements were also made for calcium, strontium and barium. The vapor pressure measurements were made with the new method of Bohdansky, using the heat-pipe effect in an open tube. Surface tension and density measurements were made by the maximum bubble pressure method. The vapor pressure measurements make it possible to evaluate the boiling point, the heat of vaporization and the vapor density. Data sheets are presented for surface tension, vapor pressure and vapor density. Data sheets for density, viscosity and vapor viscosity selected from the literature are also presented.
Author

N68-14763# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
BIBLIOGRAPHICAL REVIEW OF DNB DATA IN NON-UNIFORMLY HEATED CHANNELS AND COMPARISON WITH THEORETICAL PREDICTIONS BY WAPD-188, W-2 AND W-3 CORRELATIONS
M. Guyette and N. Hoppe Brussels EURATOM Nov. 1967 49 p refs Presented at the European Two-Phase Flow Group Meeting, Bournemouth, England, 12–15 Jun. 1967
(Contract EURATOM-001-64-1-TRUB)
(EUR-3397.E; EURAEC-1915)

A bibliographical review of Departure Nucleate Boiling (DNB) data in non-uniformly heated channels has been carried out. The analysis of these data shows that the influence of the non-uniformities on the DNB decreases when the inlet quality increases, all the other parameters (geometry, pressure, mass velocity) being kept unchanged. Various methods of predicting DNB in non-uniformly heated channels are examined. A comparison between experimental values and theoretical predictions shows that the use of the F factor developed by Westinghouse, always improves the validity of the predictions for all the considered correlations. In the case of marked non-uniformities like hot patches and low qualities the discrepancies between experimental values and theoretical predictions are generally too large as to allow the use of the selected method of calculation for detailed design and performance studies.
Author

N68-14793# Societa Ricerche Impianti Nucleari, Saluggia (Italy).
LOCATING OBSTRUCTIONS IN HOT WATER PIPES BY THE USE OF RADIOACTIVE ISOTOPES IN SEALED-SOURCE FORM [LOCALIZZAZIONE DELLE OSTRUZIONI IN TUBAZIONI PER ACQUA CALDA MEDIANTE L'IMPIEGO DI ISOTOPI RADIOATTIVI SOTTO FORMA DISORGENTI SIGILLATE] Final Report
A. Bruna, P. G. Caldera, and P. L. Tarditi Brussels EURATOM Nov. 1967 26 p In ITALIAN; ENGLISH summary
(Contract EURATOM-095-65-10 IRAI)
(EUR-3646.I)

The report describes experimental work on the feasibility of using radioisotopes in sealed-source form to locate obstruction points in hot-water pipes, with special regard to radiant panels. The experiments were conducted first on lengths of tubing, then on laboratory-mounted panels, and lastly on three types of installation. With partial stoppages the point of occlusion is identified with very good accuracy; in cases of total stoppage, rarely encountered in practice, the occlusion point is located to within 20–100 cm depending on the length of the pipe coil. An assessment is made of the applicability of the method and of its conformity with the Basic Standards for the protection of workers exposed to ionizing radiations.
Author

N68-14798 Bundesministerium fuer Wissenschaftliche Forschung, Bad Godesberg (West Germany).
SPECTROSCOPIC ANALYSIS OF ALKALI LINES AT FLAME TEMPERATURE [SPEKTROSKOPISCHE UNTERSUCHUNGEN VON ALKALILINIEN BEI FLAMMENTEMPERATUREN]
J. Heberlein Mar. 1967 80 p refs In GERMAN; ENGLISH summary
(BMWF-FBK-67-19)

In a propane–air flame vaccinated with alkali metal atoms the temperature was determined by an inverse method through measurement of the relative total intensities. In addition, the absolute growth and Gouy diagrams were obtained. The absorption parameter and the collision cross sections as well as the concentration of the dissociated metal atoms in the flame were derived from these curves. The value of the collision cross section increases with the growing atomic weights, according to the collision theory of Weisskopf–Lindholm. The results are compared with those of other investigators.
K.W.

N68-14812# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Fiziko-Energeticheskii Institut.
CRITICAL PARAMETERS OF ALKALI METALS [KRITICHESKIE PARAMETRY SHCHELOCHNYKH METALLOV]
P. L. Kirillov 1966 32 p refs In RUSSIAN
(FEI-52)

Knowledge of the critical parameters is necessary in generalizing data on heat transfer in a two-phase region and on critical heat fluxes of alkali metals on the basis of the theory of thermodynamic similarity, but existing methods of calculating the critical parameters involve empirical dependences based on approximate thermodynamic similarity. Those parameters can be very correctly obtained from the van der Waal constants with consideration of vapor dimerization, and with them generalized expressions can be obtained for the heat of evaporation, surface tension, and vapor pressure.
Author NSA)

N68-14850# Los Alamos Scientific Lab., N. Mex.
LIQUID STRUCTURE AS DEDUCED FROM PRECISE THERMODYNAMIC MEASUREMENTS

Guy R. B. Elliott, Donald R. Conant, Harold S. Swofford, Jr., and Barton L. Houseman [1967] 35 p refs Presented at the 3d Intern. Symp. on High Temp. Technol., Pacific Grove, Calif.
(Contract W-7405-ENG-36)
(LA-DC-8804; CONF-670935-4) CFSTI: HC $3.00/MF $0.65

Recently new techniques have been developed and older techniques have been improved so that changes of thermodynamic activity with composition can now be followed rather precisely in certain alloy systems. A general picture is presented regarding the information of this type which has been developed. The measurements have demonstrated that, although certain alloy systems may be fitted by simple models, in many other cases these solutions are far more complicated than many theories have assumed. In effect, the ordering forces of enthalpy and bonding may often be far more predominant than the randomizing forces related to temperature and entropy, and solid-like models seem called for to describe the short-range order in many strongly-bonded liquid alloys. The activity-mole fraction plots, which have often been treated as smooth curves, can frequently be shown to be series of almost linear segments. Sometimes these segments connect with other segments by rather sharp changes of slope. Even certain precise measurements of the water activity for ionic solutions show this behavior. In other cases regions of unchanging activity (liquid two-phase regions) connect these segments. Information used includes vapor pressure measurements using isopiestic balances, concentration cell emfs, electrical conductivity, and freezing point depression. Author (NSA)

N68-14911 Commissariat a l'Energie Atomique, Sevran (France).
EXPERIMENTAL AND THEORETICAL STUDY OF GENERATION OF DETONATION BY SHOCK WAVE IN A GRANULAR EXPLOSIVE [ETUDE EXPERIMENTALE ET THEORIQUE DE LA GENERATION DE LA DETONATION PAR ONDE DE CHOC DANS UN EXPLOSIF GRANULAIRE]
H. Bernier, J. M. Lezaud, and Y. Chevalier 15 Sep. 1967 6 p refs In FRENCH Presented at High Dyn. Pressure, Paris, 11–15 Sep. 1967
CFSTI: $3.00

Experimental results are reported for the generation of a shock wave detonation in a granular structure, and the precautions followed during the experiment are stressed. Besides the intensity of the pressure sensor, the main differences in this experiment over previous studies are concerned with the means of establishing the detonation. Use of a qualitative interpretation of results is confirmed by a mathematical model, and a correlation between hydrodynamic aspects and chemical kinetics is indicated for one-dimensional flow. Transl. by M.W.R.

N68-14931# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
THE SPECIFIC HEAT OF TIN AND GALLIUM IN THEIR STABLE AND UNDERCOOLED PURE LIQUID STATES Interim Technical Report
H. S. Chen and D. Turnbull Nov. 1967 16 p refs
(Contract Nonr-1866(50))
(TR-14; AD-662653)

The specific heats, C sub p, of tin and gallium in their pure liquid state over the temperature range from 632 for tin and 811 gallium to 425 and 245K, corresponding to undercoolings of 80 and 58K respectively have been measured. Over the entire temperature range, the C sub p for both tin and gallium falls continuously with increasing temperature through their melting point with no singular behavior there. The excess specific heat, delta C sub p, of the liquid over the corresponding crystal diverges with falling temperature from -0.38 for tin and 0.56 for gallium at their melting point to +0.27 and 1.04 cal/g-atm-K at the lowest temperature to which the particular specimen could be undercooled. For both tin and gallium, the specific heat at constant volume, C sub v, of the liquid at their melting point exceeds the Dulong Petit limit value of 3R, and rises with decreasing temperature. The excess specific heat, delta C sub p, as well as delta C sub v, of liquid over the corresponding crystal in the undercooled region is attributed to the taking up of configurational entropy with rising temperature. Author (TAB)

N68-14933# Esso Research and Engineering Co., Linden, N. J.
EXPLOSION PHENOMENA INTERMEDIATE BETWEEN DEFLAGRATION AND DETONATION
John A. Brown and Morton Collins Washington Office of the Chief of Res. and Develop. Oct. 1967 149 p refs
(Contract DA-49-092-ARO-140)
(AD-662778)

Explosives with stable propagation rates faster than those of conventional deflagrations and slower than those of conventional detonations should also produce intermediate pressures and action times, and could have numerous military and industrial uses. No true intermediate explosives are available at this writing (1967); but a number of intermediate velocity and pressure phenomena were observed, and some of the materials show promise of being developable into practical intermediate explosives. The report presents intermediate explosives in the context of an updated review of reaction wave theory, followed by a description and interpretation of intermediate phenomena which were observed. The phenomena fall into four categories: ideal detonation in low density media, non-ideal detonation, LVD in liquids and solids, and convective deflagration. A research plan to advance the state of the art is offered and a list of illustrative practical applications is included. An extensive bibliography, both cited and general, is given.
Author (TAB)

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-14037# European Southern Observatory, Hamburg (West Germany).
THE EUROPEAN SOUTHERN OBSERVATORY Annual Report, 1966
1967 34 p
CFSTI: HC $3.00/MF $0.65

The progress made in 1966 concerning building activities in Headquarters Santiago and the instruments installed in La Silla are described e.g. prism astrolabe, prism astrograph, photometric telescope, spectrographic telescope, Schmidt telescope, 3.5 m telescope etc. Astronomical observing activity was started late in November. References to the annual reports 1964 and 1965 are made in order to avoid recapitulation. ESRO

N68-14119# Bochum Observatory (West Germany). Inst. for Satellite and Space Research.
THE INSTITUTE FOR SATELLITE AND SPACE RESEARCH [INSTITUT FUER SATELLITEN- UND WELTRAUMFORSCHUNG. JAHRESBERICHT 1966] Annual Report, 1966
H. Kaminski 1967 14 p In GERMAN
CFSTI: HC $3.00/MF $0.65

As to buildings and installations at the Observatory a 20 m parabolic antenna was mounted (tests in the frequency range 183–2300 MHz began) and a quadruple helical antenna overhauled. Technical and scientific activities comprise work on a television telescope, aerial camera for satellite photographs, recording of the solar X-rays of the satellite 1965–93 A of NRL and recording of the Faraday effect. Furthermore, the differential Doppler effect on

the frequencies 40 and 360 MHz (Satellite 1964–66 A) was determined. Radio pictures of the US meteorological satellites ESSA 2 and Nimbus 2 were recorded. A receiving device was installed for the continuous reception of time signal transmittance in the frequency range of 75 KHz. ESRO

N68-14120# Oak Ridge National Lab., Tenn.
INDICES OF QUALITATIVE VARIATION
Allen R. Wilcox Oct. 1967 30 p refs Supported in part by ARPA
(Contract W-7405-ENG-26)
(ORNL-TM-1919) CFSTI: HC $3.00/MF $0.65

A statistical approach to analysis of public opinion on continental defense is presented. Indices of qualitative variation are developed for opinion sampling analysis. A computer program NOMSAT, for calculating the indices of variation is given. NSA

N68-14271 Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA: SCIENCE AND TECHNOLOGY, NUMBER 397
4 Jan. 1968 21 p Transl. into ENGLISH from Chinese
(JPRS-43872) CFSTI: $3.00

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1. BIOGRAPHY OF A TYPHOON K'o-c. Tung p 1–7 (See N68-14272 05-20)

2. FORECASTING EARTHQUAKES ACCORDING TO THE VARIATION OF GEOMAGNETISM Ta P'eng p 8

3. THE USE OF ORGANIC MATTER IN RAIN-MAKING Yuan p 9

4. CLOUD SEEDING FOR SNOW C.-t. Yeh p 10–14 (See N68-14273 05-20)

N68-14381# Joint Publications Research Service, Washington, D. C.
PROBLEMS OF CYBERNETICS AND LAW
V. N. Kudryavtsev, ed. 10 Jan. 1968 378 p refs Transl. into ENGLISH of the book "Voprosy Kibernetiki i Pravo" Moscow, Nauka, 1967 p 1–312
(JPRS-43954) CFSTI: HC $3.00/MF $0.65

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8. QUESTIONS CONCERNING AN IMPROVEMENT IN CRIMINAL RECORD KEEPING V. V. Pankratov p 158–175 refs (See N68-14389 05-34)

9. THE UTILIZATION OF CYBERNETIC MACHINES AND PUNCHCARD COMPUTERS IN CONCRETE SOCIOLOGICAL STUDY OF THE CAUSES OF CRIME AND THE PERSONALITY OF THE CRIMINAL V. Ye. Chugunov and G. F. Gorskiy p 176–191 refs (See N68-14390 05-34)

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11. QUESTIONS PERTAINING TO INVESTIGATIVE REASONING IN THE LIGHT OF INFORMATION THEORY A. R. Ratinov p 213–237 refs (See N68-14392 05-34)

12. MATHEMATICAL METHODS OF INVESTIGATION IN CRIMINOLOGY Z. I. Kirsanov p 238–262 refs (See N68-14393 05-34)

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16. UTILIZATION OF THE APPARATUS OF PROJECTIVE GEOMETRY IN THE PROCESS OF THE IDENTIFICATION OF INDIVIDUALS BY THEIR PHOTOGRAPHS R. E. El'bur p 321–348 refs (See N68-14397 05-34)

17. CERTAIN QUESTIONS CONCERNING THE THEORY OF IDENTIFICATION OF OBJECTS WITH THE USE OF THE APPARATUS OF PROJECTIVE GEOMETRY V. Yurans p 349–360 refs (See N68-14398 05-34)

18. ABOUT THE IDENTIFICATION OF IMAGES OF SPATIAL OBJECTS L. A. Rastrigin p 361–368 (See N68-14399 05-34)

N68-14382# Joint Publications Research Service, Washington, D. C.
PROSPECTS INVOLVED IN THE UTILIZATION OF CYBERNETIC ACHIEVEMENTS IN THE OPERATION OF LEGAL ESTABLISHMENTS
A. R. Shlyakov *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 6–20 refs (See N68-14381 05-34)

The possibility of utilizing cybernetic methods to create laws, to resolve concrete legal tasks, and for research in the field of legal investigation, is discussed. Statistical data of many types lend themselves to mathematical treatment and computerized techniques. L.S.

N68-14383# Joint Publications Research Service, Washington, D. C.
HANDLING OF LEGAL EVIDENCE IN THE LIGHT OF CYBERNETIC IDEAS
A. I. Trusov *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 21–38 refs (See N68-14381 05-34)

Isomorphic relationships of legal evidence are described. Evidence is considered to be an information signal lending itself to cybernetic means of handling such data through the use of codes. The possibilities of formalizing the legal process of presenting evidence by cybernetic means are discussed. The elements of the process (investigator, prosecutor, judge, accused, defender, victim, witness, and others; along with their functions) are considered. Means of transforming probable knowledge into reliable knowledge are examined. L.S.

N68-14384# Joint Publications Research Service, Washington, D. C.
A STUDY OF LAW USING METHODS OF MATHEMATICAL LOGIC

O. A. Gavrilov *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 39–70 refs (See N68-14381 05-34)

Propositional calculus (sentential logic) is used to define an information language useful in analyzing legal procedures by seans of mathematical logic. Set theory symbology is used. Examples of legal and procedural standards for criminal cases, evolved from the hypothesis, are presented. L.S.

N68-14385# Joint Publications Research Service, Washington, D. C.

ABOUT A REFERENCE-INFORMATION SERVICE IN THE FIELD OF LAW

D. A. Kerimov *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 71–96 refs (See N68-14381 05-34)

The use of a symbolic language, information selection criteria; computer storage facilities; search procedures; and printout procedures for a legal reference information service are described. L.S.

N68-14386# Joint Publications Research Service, Washington, D. C.

ABOUT THE PROGRAMMING OF THE PROCESS INVOLVING THE APPLICATION OF LEGAL STANDARDS

V. N. Kudryavtsev *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 97–116 refs (See N68-14381 05-34)

The organization of concepts pertinent to correct application of a legal standard to decide a case is examined. These concepts include: 1) analysis of the factual circumstances of the case, 2) selection of the appropriate standards, 3) verification of the accuracy (authenticity) of the text of the legal source containing the required standard, and the determination of its power, 4) understanding of the sense and content of the standard, 5) interpretation of the standard, 6) the adoption of a decision, and the issuance of a judicial document consolidating the decision. A graphical portrayal of a qualification program leading to a decision, is presented. L.S.

N68-14387# Joint Publications Research Service, Washington, D. C.

ABOUT THE QUESTION OF FORMALIZING A BRANCH OF THE LAW

V. M. Kogan *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 117–134 refs (See N68-14381 05-34)

The use of mathematical logic in formalizing criminal law is discussed. The treatment of theft according to Soviet law and to the laws of other nations is examined. Differences in terminology between Soviet and other national laws relating to criminal law are discussed. The functioning of criminal law as a special part of the general law; the functioning of law in space; and punishment goals, are discussed. It is stated that formalism guarantees stability and equality before the law, whereas the overcoming of formalism on the basis of the law itself guarantees a close tie between the court decisions and life, thereby ensuring justice in each individual case. L.S.

N68-14388# Joint Publications Research Service, Washington, D. C.

CYBERNETICS AND THE RESOLUTION OF CERTAIN LEGAL TASKS

A. F. Deyev, L. G. Gal'perin, and Yu. T. Ivanov *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 135–157 refs (See N68-14381 05-34)

The use of mathematical methods for resolving a narrow legal task, the processing of information in the field of legal standards in labor which regulate the discharge of a worker in accordance with his own wish, is discussed. Appropriate articles and decrees from the Soviet Labor Law Codes were used as reference material. Algorithms and programs were compiled, on the basis of an interpretation of the selected articles and their interrelation, which would provide an answer to the main question. Symbology was used to define parameters, (some examples of which are (1) date of discharge statement, (2) number of days left before discharge, (3) grounds for discharge noted by worker, (4) size of discharge pay, etc.). Functions utilizing the parameters are developed; and flow charts incorporating these functions into algorithms are depicted. L.S.

N68-14389# Joint Publications Research Service, Washington, D. C.

QUESTIONS CONCERNING AN IMPROVEMENT IN CRIMINAL RECORD KEEPING

V. V. Pankratov *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 158–175 refs (See N68-14381 05-34)

The causes and conditions giving rise to crime in the Soviet Union are analyzed. Forms of criminal record keeping; statistical data kept; volume of data; automation of the processing of data; and information retrieval setups for centralization and unification of the record keeping, are discussed. Various units (tapes, drums, computers, etc) comprising an automated system are described. The operational activities of various investigative agencies from which data are generated, are also described. L.S.

N68-14390# Joint Publications Research Service, Washington, D. C.

THE UTILIZATION OF CYBERNETIC MACHINES AND PUNCHCARD COMPUTERS IN CONCRETE SOCIOLOGICAL STUDY OF THE CAUSES OF CRIME AND THE PERSONALITY OF THE CRIMINAL

V. Ye. Chugunov and G. F. Gorskiy *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 176–191 refs (See N68-14381 05-34)

The computer processing of sociological data relating to the causes of crime and the criminal personality, obtained from questionaire surveys, is described. The data include biographical data; sociopolitical characteristics of the individual (education, party affiliation, occupation, social position, birthdate, residence, previous criminal record, personal habits, etc.); a brief description of the crime; causes and conditions characterizing the causes and conditions of the crime; motive; methods used in detecting the crime; and investigative facilities used. Coding of the data is described. The computer is able to simulate criminal processes from the data input to aid in identification and legal prosecution of criminals. L.S.

N68-14391# Joint Publications Research Service, Washington, D. C.

CERTAIN QUESTIONS CONCERNING EVALUATIONS AS A QUANTITATIVE CHARACTERISTIC OF THE RELIABILITY OF PROOF

A. A. Eysman *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 192–212 refs (See N68-14381 05-34)

An analysis of the logical structure of legal proof is presented and applied to determining the possibility or impossibility of applying certain quantitative methods in evaluating the reliability of proof (testimonies, documents, evidence found on the person, threats, flight, presence at the scene, etc.). A structural analogy is revealed which exists between the systems of mathematical accumulation of data, diffusion, and exclusion, and the schemes of reasoning used in symbolic logic, probability theory, and information theory. L.S.

N68-14392# Joint Publications Research Service, Washington, D. C.

QUESTIONS PERTAINING TO INVESTIGATIVE REASONING IN THE LIGHT OF INFORMATION THEORY

A. R. Ratinov *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 213–237 refs (See N68-14381 05-34)

The mental process involved in the acquisition of knowledge (data) is applied to investigative reasoning in legal procedures in criminal cases. The process of knowing is looked upon as consisting of the influence of the sensory and verbal information flows into man's consciousness exerted by the outside (objective) world on his cognitive capability, resulting in concepts that correspond to the object being reflected. The assumption that people learn about the world through models of information leads to influencing the cognitive capability of man by influencing the models. L.S.

N68-14393# Joint Publications Research Service, Washington, D. C.

MATHEMATICAL METHODS OF INVESTIGATION IN CRIMINOLOGY

Z. I. Kirsanov *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 238–262 refs (See N68-14381 05-34)

The use of mathematical models and methods in identifying individuals from data (photographs, sex, age, nationality, etc.) for proof in criminological investigations is discussed. Identification usually takes place by the systematic narrowing down of aggregates of coinciding features. Probability theory and statistics are used in identifying the significance of the individual features, and in determining the interdependence existing between them. Other features lending themselves to mathematical investigation are tracks, footprint measurements, vehicle tracks, marks left by weapons, colors, geometry, and handwriting. Applications of formulas to these features are given L.S.

N68-14394# Joint Publications Research Service, Washington, D. C.

CYBERNETICS AND CERTAIN QUESTIONS PERTAINING TO LEGAL GRAPHOLOGY

L. G. Edzubov *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 263–293 refs (See N68-14381 05-34)

The use of algorithms for identifying written images for the purpose of obtaining legal proof based upon handwriting is discussed. Spatial characteristics of written letters are described; and coding of letters is examined by means of a coordinate grid in which portions of the letter can be treated mathematically from a treatment of the grid areas. The possibilities of using an averaging method for written symbols in legal graphology are discussed. Simulation methods for studying interference in the execution of written symbols; and averaging of written symbols are described. L.S.

N68-14395# Joint Publications Research Service, Washington, D. C.

CYBERNETIC SIMULATION IN THE STUDY OF HANDWRITING

R. M. Lantsman *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 294–302 refs (See N68-14381 05-34)

Certain aspects of handwriting are examined by means of mathematical models utilizing statistical and probability theory, symbolic logic, and cybernetic tools for simulation purposes. An example of a formulated mathematical problem of graphical differentiation of letters in a handwriting sample, is presented. The technique described is applicable to legal graphology. L.S.

N68-14396# Joint Publications Research Service, Washington, D. C.

ON THE UTILIZATION OF MATHEMATICAL METHODS IN EXPERT HANDWRITING ANALYSIS

V. P. Vlasov *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 303–320 refs (See N68-14381 05-34)

The use of probability theory for substantiating conclusions of handwriting experts is described. Features of handwriting lending themselves to mathematical analysis include: (1) angle of stroke, (2) dimensions of letters (height, etc.), (3) directions, (4) frequency and size of gaps in strokes, (5) open and closed curves (their number and distance from base of the line), (6) angle sizes, plus others. Measurements of these features (by protractors and other instruments) are recorded in tables, average values are calculated, and graphs are plotted. Coincidences or differences in the character of the curves are grounds for a conclusion. Mathematical methods to cut down on the time of analysis are discussed. L.S.

N68-14397# Joint Publications Research Service, Washington, D. C.

UTILIZATION OF THE APPARATUS OF PROJECTIVE GEOMETRY IN THE PROCESS OF THE IDENTIFICATION OF INDIVIDUALS BY THEIR PHOTOGRAPHS

R. E. El'bur *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 321–348 refs (See N68-14381 05-34)

Possibilities of using various points from descriptive and projective geometry to resolve facial features in photographs are examined. Systems of equations describing coordinate points of photographs are presented. Machine processing techniques of examining photographs were compared to manual analysis of the characteristics. Shortcomings of the described geometric methods are acknowledged; and it is suggested that a method of introducing optical–mechanical devices for a more objective laying out of the constant points, and a more perfect algorithm excluded from all surplus structures, are needed. L.S.

N68-14398# Joint Publications Research Service, Washington, D. C.

CERTAIN QUESTIONS CONCERNING THE THEORY OF IDENTIFICATION OF OBJECTS WITH THE USE OF THE APPARATUS OF PROJECTIVE GEOMETRY

V. Yurans *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 349–360 refs (See N68-14381 05-34)

A projective geometric procedure was used in a graphical study of the external features of a person on photographs. The geometrical relationships for points of intersection of straight lines are given. Examples of a graphic algorithmic procedure for confirming the identity of images are presented. L.S.

N68-14399# Joint Publications Research Service, Washington, D. C.

ABOUT THE IDENTIFICATION OF IMAGES OF SPATIAL OBJECTS

L. A. Rastrigin *In its* Probl. of Cybernetics and the Law 10 Jan. 1968 p 361–368 (See N68-14381 05-34)

Statistical methods are used to solve a problem concerning the identification of plane images (e.g. photographs). A concept utilizing an optimal identification algorithm, based on a minimization of the degree of non-correspondence between the two images being examined, is described. The structure of a specialized analog computer for use in the identification process is also proposed. L.S.

N68-14577# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

UNDERWATER SYSTEMS WITHIN THE EVOLVING SCIENTIFIC, TECHNOLOGICAL, AND ECONOMIC FRAMEWORK

Carl F. Kottler, Jr. Jan. 1968 121 p refs

(RE-314)

The increasing worldwide importance of underwater oceanographic activity has led to the consideration of inner space as an area in which to apply its capabilities. In this context, this report presents the scientific, technological, and economic framework within which various underwater systems are evolving. The PX-15 submersible and the intended underwater Gulf Stream drift mission are discussed in relation to furthering underwater technology and

oceanographic research work. Possible follow-on missions are considered. Submarine hull materials research is discussed in regard to the promising potential of glass and glass-ceramics for hull applications. Underwater operations including homesteading and the exploitation of mineral reserves are analyzed from which it is concluded that cargo/tanker submarine and other oceanic structures (both mobile as well as emplaced types) are greatly needed. A review of the new underwater techniques for living and working on the ocean bottom is presented. Author

N68-14618 Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE THREE-INDEX TRANSPORT PROBLEM
G. D. Rakhmanin, S. S. Surin, and G. V. Shalabin [1967] 10 p Transl. into ENGLISH from the book "Application of Mathematics to Economics" Leningrad, Leningrad Univ. Press, 1965 p 124–133

An algorithm is developed for the transport and storage problem in the petroleum industry for the optimal location of the industry in a geographic region. The stages covered are storage at the refinery, transport to the distributor, storage at the distributor's, and transport to the consumer. For a short-range planning problem, only the current expenditures are considered. For long-range planning the capital expenditures at storage and refinery areas and in the transport are also included. N.E.N.

N68-14620# Federal Aviation Agency, Washington, D. C. Dept. of Transportation.
ACCESS TO AIRPORTS. SELECTED REFERENCES, BIBLIOGRAPHIC LIST NO. 12—SUPPLEMENT
Louise K. Annus, comp. Nov. 1967 11 p refs
(AD-662414)

Contents: General; Air Transportation; Motor Transportation; Rail Transportation; Skylounge. TAB

N68-14624*# Oklahoma Univ., Norman. Dept. of Political Science.
THE ROLE OF SMALL BUSINESS IN FEDERAL GOVERNMENT R&D CONTRACTING: THE MSC EXPERIENCE
Carol S. Mollison (M.S. Thesis) Houston, Tex. NASA. Manned Spacecraft Center Dec. 1967 50 p refs Sponsored by NASA
(NASA-CR-65916; MSC-BM-MR-67-5) CFSTI: HC $3.00/MF $0.65 CSCL 05A

Success and failure experiences of the NASA Manned Spacecraft Center (MSC) in doing business with small business firms are discussed. The NASA MSC Small Business Program is described; and both the MSC and company viewpoints are presented. Research and development contract negotiations and awards are analyzed. Case study histories of business dealings are given. Recommendations for strengthening and making more effective the MSC Small Business Program are made. L.S.

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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